EVALUATING USER CHANGE REQUESTS IN FACILITY CONSTRUCTION

THESIS

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Master of Science in Engineering Management

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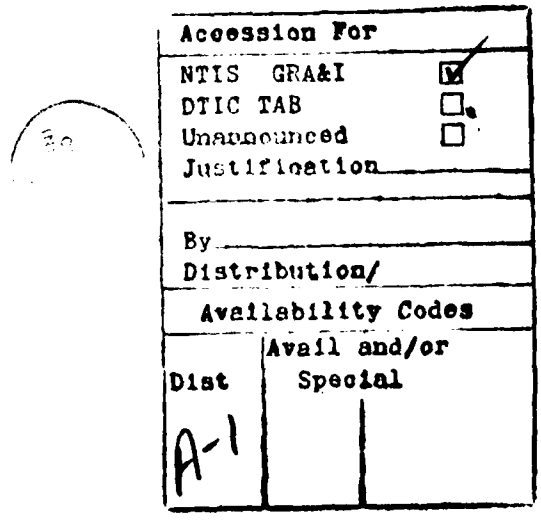
Preface

The purpose of this research was to investigate the manner in which design and construction project managers evaluate change requests to the design and construction of facility projects. The facility occupant or other agency impacted by the facility project is a major source of requested changes. Regulations and management plans provide some guidance to project managers on evaluation of these requests. The project manager is aware that user change requests increases costs and delays project completion dates. However, the project manager must weigh this consideration with serving the customer by building quality facilities to enhance the customers' productivity. This research interviewed expert project managers to conclude with important issues the project manager should understand about this evaluation process.

In conducting this research, I am deeply indebted to, first and foremost, my thesis advisor, Major Larry Lawrence. His enthusiastic support, timely feedback, and probing questions greatly assisted in the formulation and assembly of a coherent study. I also want to thank my thesis reader, Major Larry Emmelhainz, for overseeing the progress and providing valuable information. Finally, I wish to thank the personnel at the Air Force Regional Civil Engineer (AFRCE) Central Region and Ballistic Missile support, and in the Engineering Branch at Headquarters

Strategic Air Command for their hospitality and for allowing me to interview their personnel, so I could gather the data to develop the conclusions of this research.



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Abstract

This research examines the evaluation process of Air Force design and construction project managers on user requested changes to facility construction projects. Project managers who incorporate user requested changes probably enhance the facility quality, but also adversely affect the project execution (on time and within available resources) and the Air Force image before Congress. The researcher interviewed 27 experienced project managers in 3 different organizations on their decision-making processes to balance the tradeoffs between cost, performance, enhancing user productivity, and schedule.

This research employs a "reason analysis" methodology. Therefore, this research develops rather than tests a specific hypothesis. Frequency counts and open-ended questions help show the most important criteria in the decision making process. Relating responses of various questions helped the researcher gain insights into the change request process in general.

The research developed an information guide for use by Air Force project managers when evaluating user change requests. This guide helps to educate project managers from the experiences of other project managers.

Evaluating user change requests includes the following three major areas: their early detection, the administrative process, and the evaluation factors. Early detection of user change requests are derived from factors that caused revisions to the original change request. The administrative process includes those procedural items judged most important by the interviewees. The research divided the evaluation factors into two classifications. The first group addresses why project managers act as they do in evaluating the requests. The second group identifies the factor associated with either the facility quality or project execution. Also, the research scores these evaluation factors according to their importance and difficulty of use, as perceived by the project managers.

EVALUATING USER CHANGE REQUESTS IN FACILITY CONSTRUCTION

I. Introduction

Chapter Overview

This chapter provides background information with this research's general issue: impacts of user requested changes to Military Construction (MILCON) projects. In addition, this chapter states the research's problem statement, research objectives, and the research's scope and limitations.

Background

A MILCON project ". . . starts when a requirement for a facility is identified and ends with a completed facility that hopefully satisfied the requirement" (33:1). Congress annually approves projects over $200 thousand in the MILCON program by the Military Construction Authorization and Military Construction Appropriation Acts (15:10). The MILCON process consists of the following five phases: (1) requirements development, (2) validation, (3) programming, (4) design, and (5) construction (37:1). The user may request changes during any phase of the MILCON process.

AFR 89-1, Design and Construction Management, outlines the policies, goals, and responsibilities for the design

and construction of Air Force facilities. AFR 89-1 applies to MILCON projects, as well as other types of construction programs.

The goal of the design and construction phases of all programs ". . . is to satisfy the user's needs with quality construction" (11:4). AFR 89-1 defines the user as "The lowest level commander exercising operational control over the function for which the project is programmed" (11:30). AFR 89-1 also states that:

> The primary objective of design and construction management is to acquire quality facilities on time and within available resources. The facilities must be reliable and maintainable, meet prescribed environmental standards, and enhance user productivity and livability. (11:3)

The Air Force Regional Civil Engineer (AFRCE) assists with managing the design and construction phases of designated projects of the Air Force MILCON Program (10:1). There are four AFRCEs (Eastern Region, Western Region, Central Region, and the AFRCE for Ballistic Missile Support (BMS)). The continental United States (CONUS) is divided into three geographical regions, with one AFRCE assigned to a region. The BMS AFRCE is responsible for the construction supporting the MX (Peacekeeper) missile system. In addition, the MAJCOMs may be delegated AFRCE responsibilities (10:2). Some of the AFRCE responsibilities include the following:

1. Issue directives to assure cost control.

2. Furnish the design/construction agent with Air Force criteria for design and construction.

3. Review and approve design time schedules and costs.

4. Obtain coordination from all appropriate agencies on the functional adequacy of the construction plans (10:3).

The "project book" contains detailed user requirements for each MILCON project, unless the design manager waives the requirement to prepare a project book (13:8). In addition to the user requirements, the project book contains MAJCOM policies, functional requirements, and cost information (11:29). The MAJCOM is responsible for preparing the project book during the programming phase of the MILCON process. The information in the project book serves as the basis to prepare the construction plans and specifications.

The purpose of the project book is to document all data, criteria and functional requirements for the facility design and construction. The user plays a key role in preparing the project book. If the user provides a quality description of their functional requirements for the project book, the user involvement during the design and construction phases of the MILCON process should be minimal (33:11).

Changes and Their Impact on the MILCON Process

Stollbrink, in his thesis, writes about the impact of changes during the last three phases (programming, design, and construction) in MILCON projects. He states that:

> Changes during the programming phase usually do not pose major problems as they often involve changing the scope of the project. However, this could delay project approval and if the scope change is large and occurs after the project has been approved it could delay or kill the project.
>
> Changes during the design phase can cause more significant problems, especially if they require an increase in project scope and/or a major redesign effort. Changes during the construction phase are typically very expensive and should be avoided at all costs.
>
> Changes during the design and/or construction phases can also cause costly time delays. Changes during the design phase can also result in possible loss of the project due to increased cost. (33:1-2)

Stollbrink identifies one possible reason why Civil Engineers must evaluate change requests in the design and construction phases of a project. He states that the project book information may not be current for several reasons. The first reason is that the user may not have passed all known requirements to Civil Engineering. Stollbrink surveyed users of MILCON projects completed in 1984 and 1985. He reported that most users felt project books adequately described their requirements, although 26.7 percent felt that project books described their functional requirements to a low degree (33:31). The second reason for the project book containing insufficient or out-dated information is that a substantial percentage

(38.1 percent) of the users were not aware of the purpose of the project book (33:27).

Major General Wright (retired, previous Director of Engineering and Services in the United States Air Force) identifies another possible reason why Civil Engineering must become involved with evaluating change requests in design and construction. Major General Wright stated that the current Air Force construction process produces poor construction blueprints and specifications (38:16). He said that design packages are ". . . filled with errors, omissions, or other problems" which result in ". . . excessive changes and claims that lead to missed completion dates, inferior products, and . . . cost overruns. People end up frustrated" (38:16).

Rosmond states, in his thesis, that customer change requests are difficult to predict. The request may be in response to unpredicted changes in mission requirements, or a result of inadequate planning. The change request may represent a real facility need or be a compromise for requirements no longer needed (31:28).

Fortunately, Air Force contracts have "changes" clauses which gives the Air Force flexibility to purchase "changed" work without repeating the contract advertisement process. These clauses save a substantial administrative effort because the work change can be negotiated, under certain circumstances, with the original contractor

(31:14). Change orders provide the Air Force flexibility to accomplish mission objectives.

However, government agencies have been accused of excessive use of change orders. Criticism is focused on, among other things, not screening non-essential changes (31:28). The Defense Audit Service and the Air Force Audit Agency criticized both the Department of Defense (DOD) and the Air Force, in audits conducted in 1982 and 1987, for not screening user change requests (31:28; 14:9). The results of the 1987 audit are explained below.

The Air Force Audit Agency, as part of a 1987 DOD-wide audit, studied whether the Air Force was exercising adequate control over construction changes. The Agency reviewed 146 change requests (worth $12.3 million) and disclosed that 89 changes (worth $9.3 million) could have been voided. They also determined that changes delayed construction up to three months (14:6-7). The Agency recommended that procedural improvements were needed to (among other items): "a. Identify essential changes before construction begins. b. Limit user-requested changes to mission essential changes" (14:Cover letter).

In addition, the Engineering and Services Directorate at Headquarters Air Force analyzed the reasons for non-execution of Air Force MILCON projects for fiscal years (FY) 1986, 1987, and 1988. Non-execution in MILCON projects occurs when the government can not award the project construction contract in the same year Congress

appropriates and authorizes funds for the project. For FY86, 48 out of 82 non-executed MILCON projects can be classified as "user-related/caused" (18:Summary). For FY87, 26 out of 56 non-executed MILCON projects can be classified as "user-related/caused" (16:Summary). For FY88, 30 out of 56 non-executed MILCON projects can be classified as "user-related/caused" (17:Summary).

User related causes are a major factor for the non-execution of MILCON projects. Below is a discussion of the Air Force policy and guidance on evaluating user requested changes.

Policy on Evaluating User Requested Changes

From 1978 till 1988, the 1978 version of AFR 89-1 provided policy and guidance to Civil Engineering on how to evaluate change requests in design and construction. If the 1982 and 1987 audits show the Air Force was not effectively screening user change requests, then this regulation's guidance was either incorrect, insufficient, or not being followed. The 1978 version of AFR 89-1 addressed the following two areas of evaluating change requests: coordinating with various agencies and determining the impacts of the change. The following is a discussion of these areas.

First, the 1978 version of AFR 89-1 addressed the coordination process by stating that the MAJCOM has the responsibility for internal communications during the

design. The review process includes coordination with the following agencies: communications, safety, bioenvironmental engineer, security police, fire department, and the user (13:7-5). After construction contract award, the MAJCOM is responsible for coordination (among other duties) of construction (13:12-2).

Second, to address the impacts of change, the 1978 version of AFR 89-1 stated that "Efforts by the using agencies to make functional changes after award will generally be resisted unless they are mandatory mission oriented requirements" (13:12-4). A checklist of items that assist the civil engineer in determining the mission impact of a change request include the following:

1. Does the change fit within scope of project and construction contract?

2. How does change affect contractor's schedule?

3. What is status of project at time of change?

4. How is his work force affected?

5. Will subcontractors be involved (13:12-4)?

The Air Staff published a revision AFR 89-1 on 1 November 1988 to provide new and updated guidance to design and construction project managers on evaluating change requests. This version of AFR 89-1 ". . . gives increased flexibility to the MAJCOMs for design and construction of their programs. . . ." (11:24). It also addresses evaluating user changes in both the design and construction

management sections. The following is a discussion of that evaluation process.

The latest version of AFR 89-1 addresses user requested changes for projects more than 35 percent complete in design by stating that the host and requiring MAJCOM "Validates and approves user-proposed comments after the 35 percent design approval only when the change is necessary to meet the mission" (11:14). It also identifies implementation procedures for three types of changes (mandatory changes, optional changes, and user requested changes) that could occur after construction starts. Mandatory changes are necessary to satisfy safety and minimum technical adequacy requirements. Optional changes are not mandatory for the facility to function (11:9). To implement user requested changes:

> The requiring MAJCOM validates and approves user change requests, to the degree of funds availability, up to the PA [Programmed Amount]. The changes must be necessary to meet the mission. MAJCOMs may delegate some or all user change request authority to base level. (11:9)

A 29 January 1986 letter titled "Management of the Military Construction Program," signed by the Air Force Vice Chief of Staff, provides one possible basis for the new version of AFR 89-1. This letter states that "Air Force policy on user changes is only those changes absolutely necessary to meet the mission should be made after the concept stage (35 percent design)" (29:1). In

the same paragraph of the letter is "The user will approve the design before construction starts" (29:1). The last paragraph of this letter addresses the impacts of implementing user requested changes by stating "Failure to meet OSD execution goals has a direct impact on our ability to defend our requests for MILCON funds through the PBD cycles and on the Hill" (29:1).

Problem Statement

Incorporating user requested changes enhances the quality of facility design and construction; however, the problem is that it adversely affects the Air Force execution (on time and within resources) of the project. Quality facilities are reliable and maintainable, meet prescribed environmental standards, and enhance user productivity and livability (11:3). To obtain quality facilities and at the same time keep the project on time and within cost, requires addressing the following research objectives and questions.

Research Objectives

The objectives of this research are the following:

1. To identify factors of effective decision-making actions on user change requests.

2. To arrange these factors in a format that Civil Engineering project managers can use.

3. To recommend ways to implement these factors.

Research Questions

To investigate factors of effective decision-making techniques in evaluating user change requests, the following investigative questions must be answered:

1. What factors should be used to evaluate change requests?

2. How should the evaluation factors vary in different stages of the design and construction phases, if at all?

3. How should the factors be weighed to evaluate change requests?

4. What formal procedures should the project manager follow to process the change request?

5. What types of organizations should the user change request be coordinated with?

6. Do any existing decision support systems address how to evaluate requested changes?

Justification for Research

Air Force Civil Engineering does not build quality facilities because inaccuracies exist in project books. Incomplete or unknown requirements may cause inaccuracies in the project books. To correct these inaccuracies requires the user submitting a change request to the project manager during either design or construction. However, if the design is more than 35 percent complete and the users change the facility design criteria, for whatever

reason, the end result is the delayed completion of the Air Force facility. These delays result in the following:

1. Affect Air Force readiness because initial operational dates slip due to uncompleted facilities.

2. Require diversion of scarce resources from other projects to pay for additional design and construction costs.

3. Impacts the Air Force's ability to defend requests for future MILCON funds.

This research should help project managers evaluate user requested changes to the facility design and construction to acquire quality facilities, consequently ensuring the project is executed on time and within resources. The design and construction project managers can then determine the tradeoffs between cost, performance, and schedule for optional changes requested by the user.

Scope and Limitations

This research addresses MILCON construction projects managed by the AFRCEs or other agencies (e.g. MAJCOMs) that act as AFRCEs. Here-in-after, this research will refer to the individual managing the MILCON project in either design or construction as the "project manager" or "design and construction project manager."

Several facets limit the research. First, only CONUS construction projects that were completed within the last year or are currently under design or construction are

considered. Other types of construction, such as maintenance and repair projects, are excluded to limit the research to a manageable effort. In addition, this research does not consider non-conventional contracting methods for construction, such as "design-build contracting."

This research only addresses change requests submitted from users or other organizations outside of Civil Engineering involved with either the design or construction. These change requests may result from unforeseen or previously unidentified requirements, or from the need to correct design deficiencies to satisfy project requirements. Here-in-after, both these items will be referred to as "user changes," "user change requests" or "user requested changes."

Chapter Summary

Incorporating user requested changes enhances the quality of facility design and construction but adversely affects the Air Force execution (on time and within resources) of the project. The research objectives and questions are based on this problem. Understanding the process of effective decision-making in evaluating user requested changes should assist the project manager in identifying and balancing the relevant factors.

Incorporating user requested changes in design (beyond the conceptual design phase) delays project completion and

increases costs, while at the same time affect the Air Force's ability to acquire future MILCON funds. Project managers, who implement these requested changes, need to balance building quality facilities for the user while executing the project within money and time limitations.

The project book identifies user requirements for the MILCON project. The Civil Engineering project manager should work closely with the user in preparing design criteria for the construction. However, for one reason or another, the project book may not contain all user requirements. To correct these deficiencies will require change requests to the design or construction.

AFR 89-1 provides important guidance to Civil Engineering on how to evaluate user change requests in design and construction. AFR 89-1 has been recently revised, to allow MAJCOMs more flexibility to initiate their own procedures on evaluating user change requests. The key factor that AFR 89-1 identifies in the evaluation of change requests is "are they mission essential?" The Air Force Audit Agency highlighted this point in their 1987 review of the Air Force MILCON process.

Remaining Chapters of Thesis

The remaining chapters discuss the process to achieve the research objectives. Chapter II (Literature Review) provides a thorough background on the relevant literature of evaluating user requested changes. Chapter III

(Methodology) discusses the methods used for data collection and analysis. Chapter IV (Results) presents the summary tables of the interviewee responses. Chapter V (Analysis and Discussion) explains the research results by analyzing the summary tables. Chapter VI (Summary and Recommendations) addresses the research objectives and concludes with recommendations for further research.

II. Literature Review

Chapter Overview

User change requests represent new or different criteria to a facility design baseline. This chapter discusses the Air Force design process, and explains when the facility concept is finalized and when detailed design begins. It is also important to understand current practices on evaluating changes to design requirements and to the construction. This chapter discusses these practices both inside and outside the Air Force.

There are many publications that describe impacts of changes to design and construction. However, the researcher could not find much literature on decision-making to balance facility construction to enhance user productivity versus executing the project on time and within budget (which is the objective of this research, see Chapter I). The researcher believes managers in the weapon system acquisition process face similar tradeoff decisions. Thus, this literature review also includes information about user changes in the weapon system acquisition process, where additional information is available on managing user change requests.

What is a Baseline?

Zylstra writes about a baseline when describing government contract compliance and product acceptance. A

baseline is a snapshot of an engineering design that can be described by reviews of the product documentation (40:66). This baseline concept also applies to Air Force construction, as the product could be considered a facility. In essence, construction blueprints and specifications represent snapshots of the facility development. These blueprints and specifications change after each engineering design review. This research did not find any publications that address the construction blueprints and specifications as a baseline in Air Force Civil Engineering design reviews. However, the baseline concept is important because it represents an agreement between Civil Engineering and the customer on the characteristics of the facility.

Identifying the Baseline

In Air Force Civil Engineering, the project book best represents an initial snapshot of the facility. AFR 89-1, Design and Construction Management, states the project book contains user requirements to support design of the facility (11:29). The project book increases the probability of getting the best possible facility at minimum cost and with least amount of change (33:10-11).

A project book is normally required for each MILCON project (11:8). Inputs from the users and other third organizations involved with the facility are the basis for the design criteria, data, functional requirements, and

cost information. The project book details design information for MILCON projects (11:29).

The US Army Construction Engineering Research Laboratory (CERL) Report, Preparing and Communicating Habitability Design Information, describes the importance of the user communicating his requirements to the designer. The report states:

> Habitability is a concern for how functional a facility is to a user. Functional habitability must be integrated into the plans and specifications since the functional quality of a facility is affected by virtually all of its components. This requires intense user involvement. (5:11)

Habitability information should generally state how the various user functions will relate to each other. To help ensure that the design requirements are complete, the designers should arrange meetings with the users and conduct site visits (5:20-22).

The user design information falls into the following three different categories: (1) requirements, (2) standards, and (3) guidance. It is important for the designer to classify user inputs in the appropriate category. Requirements refer to what is needed or design goals. Requirements are specific for each project, and are most useful to the designer. Designers use standards (the second category) to satisfy these requirements. If standards do not exist, then users can recommend design information in the form of guidance (5:14).

Brauer recommends the designer also needs to be aware of prescriptive and descriptive forms of information. In describing user inputs, users often provide descriptive information, referring to how things can be done. Descriptive information contains examples of useful and innovative ideas. However, it is up to the designer to determine if user inputs can be translated into a prescriptive form, or how things ought to be (5:14-15).

Finalizing the Baseline

Audits are formal comparisons of the engineering design and documentation with the applicable baseline and user requirements. Audits are conducted and the baseline is reestablished as the products pass through the engineering design process and into production (40:66).

This concept also applies in Air Force construction. Technical and user reviews of construction blueprints and specifications are conducted when the design is 30 percent complete ". . . so that changes will not be required after award" (19:23). Upon completion of this review, the design is considered 35 percent complete. Here, the baseline is reestablished.

User requirements should not change after the design is 35 percent complete. A 29 Jan 86 letter signed by the Vice Chief of Staff of the Air Force emphasized ". . . that the final concept design [35 percent design] is the last

chance for the user to identify requirements, except for necessary mission changes" (29:1).

The design is 35 percent complete when ". . . the designer has established the basic features, materials, systems, and related costs necessary to meet the functional requirements of a facility" (11:30). The 35 percent design contains preliminary drawings, an outline of the specifications, basis of design, and a preliminary cost estimate. Also at the 35 percent design stage, consolidated user requirements and construction cost estimates are forwarded to the Secretary of Defense to become a basis of the budget estimate submittal (12:4-1). Congress approves each MILCON project based on what defense requirements are satisfied by funding of that project. The final design, to proceed to 100 percent complete, will start after Congressional approval (19:23).

The "Changes" Clause

A MILCON project typically has an Architect and Engineer (AE) contractor to prepare the construction blueprints and specifications based on Air Force criteria. In almost all cases, construction contractors would build the MILCON project. This section addresses changes to both the design and construction phases of contracting.

Rosmond writes that the "changes" clause allows the government to purchase additional work under an existing contract provided the change is within the general scope of

work of the contract. This clause saves the government a great deal of work. The government can negotiate with the original contractor, rather than competitively bid the work. Although the contractor is in a strong bargaining position, knowing that no price competition exists (31:14).

Rosmond reported that the purpose of the "changes" clause is not for the contractor to recover from his own errors of judgement or calculations (by securing additional money to pay for a loss that occurred on another part of the job). He concludes that "There is no question that the 'Changes' clause has been used for the purpose of improving the contractor's position" (31:16).

Managing Change Requests

The purpose of controlling changes is to prevent unnecessary ones and expedite approval and implementation of worthwhile ones (27:70).

Chadwick, while discussing the impact of design on the quality of facility construction, states that change control assures that the project is within schedule and budget. Failure to maintain change control leads to a great deal of trouble for the owner, and change control is often neglected until it is to late (6:73).

Chadwick writes that changes should be subject to formal control early in the design process. The key to the change control is organization, for without it, changes may accumulate into the thousands. Chadwick identifies two

test questions to answer to determine the need for the change. They are: "1. Will the change be cost-effective and not delay work elsewhere? 2. Will the related system operate safely . . . without this change?" (6:77).

In an article on construction cost control, Maevis raises two questions, similar to Chadwick, to answer before a reaching decision on a change request. The questions are the following: "(1) What is the estimated cost of the change; and (2) What effect will it have upon the completion date of the project?" (26:439). Maevis researched the United States Postal Service policy on change orders in construction. He found that:

> . . . a regional and headquarters instruction which requires that once the 30% design mark has been passed, there may be no changes to the design unless an involved review and approval process is followed. It involves the Assistant Postmaster General for Real Estate and Buildings and may go to two Senior Assistant Postmasters. General. [sic] This discourages casual or 'nice to have' changes. Again, it works. (26:439)

DeFeis wrote about the prevention of change orders in construction. He says that they may never be eliminated, especially on large projects. However, he says that a proven project management system should be implemented which includes, among other items, contract administration, including change order procedures (9:17).

DeFeis writes, similar to Chadwick, that "Procedures which process change order requests expediently and efficiently should be in place before ground is broken"

(9:18). A flow chart helps to visualize procedures to evaluate change requests. The flow chart should show change order processing paths, approvals, parties providing input, and a distribution list of copies of the change request (9:18).

Configuration Management

This section describes one possible method to manage changes. The researcher included material on the weapon system acquisition process because of the limited material on evaluating change requests in construction.

In the weapons system acquisition process, typically a Configuration Control Board (CCB) has the final approval authority on change requests in the system program. This authority could include construction change requests on facilities supporting the weapon system. Stahl, in his article, "Managing Engineering Changes," recommends that Configuration Management be established to ensure that the following six steps are applied to engineering change requests. They include the following:

1. Justification of the need.
2. Establishing the priority.
3. Preparing a proposal for organizations to review.
4. Reviewing the proposal.
5. Approving/disapproving the proposal or concur/ nonconcur in the priority.
6. Incorporating the change (32:4).

The baseline can be managed by configuration management. Configuration management is the process of controlling and accounting for a product's engineering design, from design phase through delivery. A vital role of configuration management is to control changes to an engineering design (40:66).

Configuration management policy and guidance is in MIL-STD-480, "Configuration Control-Engineering Changes, Deviations and Waivers." Among other items, this guidance provides the following:

1. Requirements for maintaining configuration control of configuration items.

2. Requirements for preparation and submission of proposed engineering changes (30:8).

In the weapon system acquisition process:

> The difficulty in dealing with the user, regarding engineering changes, is in separating goals from requirements. The relationship is clouded by changes in personnel, by changes in requirements dictated by expanded missions, and by altered threats. (30:16)

In examining the management techniques of the A-7D System Program Office, Powers writes that configuration management helped to separate goals and requirements and forced adequate and timely evaluation of the user's requests for changes (30:17). Configuration management helped to control a mixture of goals, opinions, policies and requirements by the following methods:

1. Generating and maintaining a corporate memory to show the source of changes.

2. Maintaining change request files to show the origin of need, description of changes, coordination levels and estimated costs (30:17).

Configuration Management Applications

Meiners wrote a PhD dissertation on variables that induce major changes to the weapon systems acquisition process. He also states that configuration management can control major changes and resultant cost growths in weapon systems. Configuration management:

> . . . is a discipline which integrates the technical and administrative actions of identifying and documenting the functional and physical characteristics of an item during its life cycle, controlling changes proposed to these characteristics, and providing information on the status of change actions. (27:69)

He writes that configuration management can be thought of as the way managers can control, record, and communicate the integrity and continuity of the design, engineering and cost trade-off decisions (27:70).

In weapon systems acquisitions, cost increases result when poor management of engineering changes occurs (32:3). The weapon systems process uses configuration management which:

> . . . is the engineering discipline of identifying, controlling, accounting for, and auditing the functional and physical characteristics of items . . . Configuration identification is the discipline of

> selecting the documents which identify and define the configuration characteristics of an item. These documents usually refer to specifications and drawings. . . . (32:4)

One of the reasons to apply configuration management is to ensure that the change is necessary and beneficial to the government. Configuration control provides a means to scrutinize and prioritize changes. Stahl writes that managers must ensure engineering changes meet one of the following criteria: ". . . (1) correct deficiencies, (2) satisfy a change in user requirements, (3) effect substantial life-cycle cost savings, or (4) prevent or allow desired slippage in an approved schedule" (32:4).

Effective management of engineering changes includes the following steps:

> . . . (1) justify the need, (2) establish the change as Class I [typically impacts dollars or schedule] or Class II [does not fall in Class I category], (3) prepare an engineering change proposal (ECP), (4) submit to and review by the government, (5) approve/ disapprove or concur/nonconcur in classification, and (6) incorporate the change in the item and data. (32:4)

A CCB approves or disapproves all Class I ECP's. Stahl also writes that activities and organizations such as those involved with facilities that could be affected by the proposed change should be on the CCB (32:5).

Configuration management does not apply solely to the weapons system acquisition process. Al-Subaiei's thesis is about control of changes in software maintenance. To incorporate a change into a program, software project

managers should ask the following: "Why is the change needed? What is the impact of this change on the rest of the system? What is the cost involved to do the change? How important or complicated is this change?" (4:56). These questions should be answered because incorporating a change may introduce new errors into the program. Sometimes the users may exaggerate their needs. Some user requests for changes are not justifiable for cost or technical reasons (4:57).

Guthrie and Konkel wrote about project management principles and techniques proven applicable to large construction projects that support multi-billion dollar civilian programs. They state that an essential part of project management is the disciplined control and administration of changes and revisions. The changes "must be incorporated as quickly as possible and under strictly controlled procedures" (22:D.1.3).

Configuration Management in Air Force Construction

Configuration management is not a required management procedure of Air Force Civil Engineering in construction project design. This section explains the change control process used in some Air Force construction projects.

Construction of the Aerospace Propulsion Test Facility (ASTF) facilities is an example of a project that employed configuration management. The ASTF will test jet engines

of the future (35:3). This project falls under the general heading of Research and Development (R&D).

> R&D facilities have a direct interface with flight hardware, hospital hardware or research and development hardware. Intensive management and review techniques are required on these projects. . . . R&D projects usually contain a deadly combination of high cost, tight schedule and inherent potential for change. (35:5-6)

Congress funded the ASTF in fiscal year 1977 at $437 million; but by 1982, the project experienced a significant cost increase estimated at $138 million and a schedule slip of 36 months (35:6). The simultaneous contracting, by the Air Force, for the government furnished equipment (GFE) and the construction ". . . resulted in numerous design omissions and incomplete equipment interface configuration" (36:2). Because the design lacked adequate GFE interface requirements, to accommodate the GFE would require extensive modifications and redesign (36:2).

Tucker states that the design change process included two separate boards to approve changes, the CCB and the Facility Working Group (FWG). The systems project manager chaired the CCB, which served as interface control with the entire program and approved facility change requests exceeding $25 thousand or if the change request interfaced with program equipment. The project civil engineer chaired the FWG, which reviewed and approved construction changes below $25 thousand. The ultimate goal of the construction project manager was to get the FWG or CCB to approve or

disapprove the change request. After the CCB or the FWG approved the requested change, the construction agency decided the best method to incorporate the change, e.g., current contract versus follow-on contract (35:42-43).

The researcher concludes that Tucker believes that configuration management helped to manage problems created by concurrent facility and GFE contracting. Even though the cost increases were significant configuration management helped to reduce cost increases and minimize schedule delays.

Below is a discussion of three facility management plans that address control of user changes in construction.

The AFRCE - BMS, General Instructions for MCP Designs and Construction, FY 89 and Beyond, addresses control of changes. This document states:

> Congressional and Department of Defense reviews have resulted in concerns that too many change orders are being implemented . . . . HQ USAF has directed Air Force field organizations
> to restrict change requests to mission essential changes or changes to make the facility usuable for its intended purpose. Facility Change Board operating procedures shall be used for all construction change requests. (2:11)

The second facility management plan, the Intensive Management Plan for the Medical Clinic Replacement Facility, Kirkland AFB, states:

> Those changes which are necessary to the fulfillment of the mission and/or necessary to permit construction to proceed on an orderly basis will be considered for

> immediate implementation. Non-mandatory changes can be deferred for implementation by separate procurement action. Deferred changes will be reconsidered after all mandatory items have been incorporated and the construction work is substantially complete. (3:8)

The third facility management plan, the B-1B Support Facilities Construction Management Plan, states that:

> During the design phase, the configuration of B-1B facilities will be based on the functional criteria provided by AFRCE-SAC in the original design instructions as modified during the design process. All changes made to the plans and specifications after construction contract award will be in accordance with established control procedures. (1:11)

This plan states that three types of requests exist based on usability, schedule or cost impacts. The first type is called a "Class 1" change. These changes have a ". . . significant impact on either usability, costs or schedules" (1:11). A "Class 2" change is "A mandatory change that must be made for the facility to function" (1:11). A "Class 3" change is ". . . any user originated change that does not meet the definition of a Class 1 change" (1:11).

In addition, the originator of the request recommends the change priority (either urgent or routine). The base civil engineer and site activation task force validate this priority. The originator prepares a letter with this item and the following information about the request: detailed description, justification, recommended reason for change, and signature of functional commander (1:14).

It is evident that some Air Force projects have, at least, a general process identified to evaluate requested changes. These projects use configuration management in varying degrees to implement the evaluation process.

Impacts of Changes in Construction

DeFeis writes that as competition increases among construction contractors, the bids become tighter and profit margins decline. These contractors are dependent on change orders to make a profit (9:16).

Rosmond's findings are similar in his "Analysis of Low Bidding and Change Order Rates for Navy Contracts." He states that the customer-requested change order is a way for the contractor to make opportunity profits. He also reported that a Defense Audit Service audit in 1982 attributed eleven percent of change orders in construction projects to user requests for changes (31:28).

Halpin studied the frequency and magnitude of construction time overruns. He surveyed 221 MILCON projects (from the Air Force and Army) completed between July 1967 and June 1970. He reported that user changes were the second most used reason to extend construction contracts (the first reason is design deficiencies). Halpin defined user time extensions as ". . . extensions caused by changes requested by the using agency" (23:2). These user changes accounted for an average contract extension length of 5.3 percent (of specified contract

time), as compared to an average contract extension length of 25.3 percent for all possible reasons (23:8). His conclusion is that "Reduction of designer error/changes and user errors/changes would contribute most to decreasing construction time" (23:13).

Mogreen recently studied the causes and costs of changes to military construction contracts. He selected 25 construction projects completed or under construction from 1 Jan 1984 to 30 June 1985. These projects were administered by the Corps of Engineers on Army installations (28:4). He concluded that the primary causes of cost modifications on the projects studied were design deficiencies (36.3 percent), user change requests (22.3 percent), and unknown site conditions (21.8 percent) (28:49,56).

Mogreen also wrote that:

> Functional reviews by the installation are essential to reducing user requested modifications. In general, it appeared that poor project scope definition was a major contributor to user requested changes. Projects were designed and let out for bid without a firm scope definition being communicated to the designer or user. Consequently, the designer may not have been aware of what the customer wanted and the customer not aware of what was designed until construction actually began. This problem was aggravated by personnel rotations at the installation which often resulted in the ultimate user being unfamiliar with design decisions made by his predecessor. (28:82)

Mogreen surveyed project engineers and reported that practically all agreed to the need for design reviews either "always" or "most of the time," regardless of the

project size. Also he reports that three-fourths of the respondents feel that reviews save the government money "always" or "mostly" (28:87).

Mogreen comments that checklists could be used as review aids and could standardize reviews. However, he comments that checklists are not widely distributed and seldom used. Slightly over half the respondents he surveyed said that checklists are rarely or never available to reviewers. Even having a checklist on hand would not guarantee its use (28:96-97).

Chapter Summary

The project book represents the initial baseline for construction blueprints and specifications. The baseline, which consists of user requirements, should be finalized when the design is 35 percent complete.

The literature consistently reports that user change requests delay design and construction time, and increase costs. Researchers have determined that contractors (both design and construction) sometimes rely on change orders to recover costs lost in other parts of the contract. In addition, the literature consistently states the need for in-place measures to control and evaluate user change requests.

Standardized procedures to manage user change requests applies to other customer oriented operations, such as the weapon systems acquisition process and software

development. These standardized procedures are controlled by configuration management. Configuration management helps to control changes and cost growths in weapon system projects. This literature review showed that several large Air Force construction projects instituted control measures on user requested changes. These control measures are not specifically identified as "configuration management" but the process and purpose are essentially the same.

Next Chapter of Thesis

Chapter III (Methodology) presents the steps to collect and analyze the research data. This data will address the problem statement and research objectives.

III. Methodology

Chapter Overview

This chapter presents the steps that the research employs to address the problem statement and research objectives. This research uses a "reason analysis" as a guide to study the evaluation of user requested changes in MILCON projects. Each of the five stages of reason analysis and how they relate to this research are explained in this chapter. This chapter also explains the process to draft the questionnaire used in gathering the research data, and the selection process for the personnel interviewed in this research.

Reason Analysis

The objectives of this research are the following:

1. To identify effective decision-making factors used in the evaluation of user change requests.

2. To arrange these factors in a format that civil engineering project managers can use.

3. To recommend ways to implement these factors.

This research studies the factors that cause the project manager to approve or reject a requested change by the user to the facility design or construction. An effective approach can be used to determine the causal relationships to assess the causes of people's actions and "reasons for." This approach is called a "reason analysis" (21:223).

Other individuals wrote more on the valid use of reason analysis to explain intentions or actions of individuals. Kadushin reports, in his article, that Lazarsfeld defined reason analysis as ". . . a set of procedures used in survey research to construct a causal explanation for the actions, decision, or intentions of individuals" (24:338). Kadushin also identifies when to apply reason analysis. He states that:

> Reason analysis can always be used in studying the subjective factors in any course of individual action. . . . If one wants to know how an action came to be-what steps were taken and what the key choices were . . . then no technique other than reason analysis can be used. . . . Reason analysis is usually concerned with acts that involve some sort of conscious decision; habitual acts are probably not suited for any of these models. (24:338)

Stages of Reason Analysis

Kadushin states that designing a reason analysis consists of several stages. Below is a discussion of these stages.

> First, types of action involved in the subject to be studied are distinguished one from another; second, the act is divided into phases or separate acts, if this is necessary; third, an accounting scheme is developed for each act or phase; fourth, the accounting scheme is translated into a data-collection guide . . . ; fifth, a calculus of factors must be developed so that the relative weight of different factors can be assessed. Finally, the results of this assessment are tabulated for the sample as a whole or for different segments of it. (24:340)

First Stage. The first stage of the reason analysis is to formulate a purpose and select boundaries of the

research. Zeisel's concept must be applied to this research. At first glance, if we set out to explore a person's motives, then their whole life history and physical environment would lie behind their decisions in evaluating a user requested change. It is impossible to evaluate all these reasons (39:155). However, this research includes the most important issues that could identify explanations for the action, decisions, and intentions of project managers when evaluating a user change request. This research is thus limited to the following research questions:

1. Determining the factors to use to evaluate change requests.

2. How should the factors vary based on the project status.

3. How should the factors be weighed.

4. What formal approval procedures should the project manager use to process the requests

5. What organizations should the user change request be coordinated with.

6. Do any existing decision support systems address how to evaluate requested changes.

Second Stage. The second stage of reason analysis is to decide on the types of action the research will investigate. Learning different varieties of types of behavior comes from accumulated knowledge, common sense, and informal interviewing (39:156-157). A review of the

literature provides a starting point to acquire knowledge. However, only a portion of the existing knowledge in any field is in literature, thus, the researcher expects that only a small portion of current knowledge of evaluating user change requests may be on paper. The next logical step is to solicit ideas from those believed to know what is going on (20:84).

Time prevented the use of a survey to solicit individual ideas. Instead, the questionnaire pretest phase of this research included soliciting comments from the participants on the questionnaire itself. The "Questionnaire Testing" section of this chapter discusses the pretest of the questionnaire.

Third Stage. The third stage of reason analysis is to develop an accounting scheme. The accounting scheme is ". . . an organized list of factors that are believed to be relevant causes of influences upon some action, opinion, or intention" (21:224). Further, Zeisel states that the accounting scheme:

> . . . guides the collection of information and provides the framework for its interpretation. Without such a generalizing device . . . individual decisions cannot be subjected to quantitative analysis; hence no generalizations can be made. . . . (39:159)

The accounting scheme will be used to structure the replies from the experts on evaluating user requested changes in quantitative statements and about the decision-making process in general.

Zeisel stated that "The accounting scheme provides the structure of the questionnaire. . . ." (39:188). The researcher developed the accounting scheme through pretesting of the questionnaire, which the "Questionnaire Testing" and "Questionnaire Drafting" sections of this chapter discuss.

Questionnaire Drafting. The questionnaire is the instrument to gather data to understand the motives and causes of people's actions when evaluating change requests. Clover notes that using the why approach on questionnaires is necessary to know the reasons for people's actions (7:147). However, he states that:

> Some researchers believe that there is little of value that can be learned from persons by asking them why they do what they do. It is contended that people are unable to give actual reasons because basically human beings are irrational creatures. . . . According to this view, a person should be asked only for facts that can be quickly established, and can be given mostly in simple "yes" or "no" answers. (7:147)

To address this concern, Clover states:

> . . . if it is necessary to obtain information about reasons for the actions of persons and some measure of the relative importance of the different reasons, it is altogether possible that some useful results can be secured by a correctly conducted questionnaire survey. (7:147)

Lazarsfeld, as reported by Clover, identified important conditions in "the art of asking why." First, the researcher must realize that there are many reasons for why people act as they do. Zeisel further states that just

asking why in the research may bring disappointing results. There are so many possible answers that we could not know how all these reasons fit together (39:153). It is then important that the researcher understand the second condition in "the art of asking why." The second condition is that all the reasons fall into one of three following classifications: tendencies, influences, and attributes (7:150-151). All three classifications are explained below. The third and final condition "in the art of asking why" is that "The researcher must know how to use his knowledge about this three-fold classification" (7:151).

Tendencies is the first classification that explains why people act as they do. Tendencies include physical and mental characteristics of the interviewee (7:151). For example, a project manager might not include a change request because his past experience leads him to believe the change request is not feasible for one reason or another. Zeisel refers to this condition as "predispositions." Predispositions concern personnel motives prior to the action. Zeisel uses an example of purchasing a cold cream. A person's predispositions could range from a desire to have more beautiful hands, to being less lonesome, or being more healthy (39:158-159).

The second classification that could explain why people act as they do is influences (7:151). Influences represent the external forces which cause a person to act the way he does. For example, the project manager may

require a third organization approval (i.e., influence of the third organization) on the user requested change, as spelled out in a management plan, before he approves the request.

The third classification explaining why people act as they do is attributes. Attributes are the features of the commodity such as price, size, color, shape (7:151). For example, the project manager may approve or disapprove the user change request because of the dollar value "attribute" of the change request.

Questionnaire Testing. Emory recommends after drafting the questionnaire, to test it on persons typical of the design population (21:206). Clover reports that experienced investigators know that pretesting, in the long run, saves time and money (8:142).

An important research issue was how much pretesting is needed to develop a sufficient questionnaire. Many factors impact the issue to determine the number of pretests. Clover states that one reason to pretest the questionnaire is so that interviewers can be selected (8:142). Only one researcher will conduct all interviews, thus there is no need to pretest for this reason.

Clover states another factor to determine the number of pretests is the nature and complexity of the questionnaire. Only 15 to 20 pilot interviews are sufficient to identify most of the revisions needed in a

simple questionnaire. Only five to six interviews could be "enlightening" in testing a questionnaire (8:142).

The researcher tested the questionnaire on graduate students with design and/or construction project management experience in the Graduate Engineering Management Program at the Air Force Institute of Technology (AFIT) and on construction and engineering project managers in the Headquarters Air Force Logistics Command (AFLC). The first pretest involved five graduate students. The researcher wanted to do two pretests and estimated ten students had experience in design and construction management. Thus, each pretest involved five students. While these graduate students may not be experts, they have experience in either design or construction management and therefore were considered to be a valid test group. The cover letter to the initial questionnaire stated the research problem statement and objectives then asked the participants to consider the following:

1. Can the interviewee can answer all questions?
2. Is there a logical sequence of questions?
3. Do the questions have a proper balance between generality and specificity?
4. Is the question clear or the wording biased?
5. Should questions be added or eliminated, other suggestions?

To obtain comments, the researcher discussed the questionnaire with each graduate student. The researcher

incorporated their comments into another draft of the questionnaire.

This revised questionnaire served as the basis to conduct semi-structured interviews on the second group of AFIT graduate students. Again, while these graduate students may not be experts, they have experience in either design or construction management and therefore were considered to be a valid test group.

After interviews with this second group of AFIT students, the researcher incorporated their comments into what the researcher believed was a final version of the questionnaire. Headquarters AFLC supervisory personnel in Engineering and Services recommended six personnel in design and construction, with sufficient experience, that would be excellent for the research. However, the interviews with six design and construction project managers at Headquarters AFLC revealed inaccuracies and misunderstandings in the questionnaire. The researcher decided to incorporate their comments into a second final version of the questionnaire.

As a summary, the researcher developed the questionnaire through three different versions and conducted sixteen trial interviews. This questionnaire represents the accounting scheme for the "reason analysis." Appendix A contains the final interview questions.

Fourth Stage. The forth stage in the reason analysis process is the actual interviewing (39:171). Below is a

description of the universe, population, and sample of participants relevant to this research. This stage also includes a description of the data gathering process.

The Universe. The universe for this research consists of all Air Force personnel who are design or construction project managers. These personnel could be assigned to either engineering design or construction management offices in Civil Engineering. These personnel may be at the MAJCOM, AFRCE, or base level Civil Engineering agencies.

The Population. The population of interest is the group of "experts" who use effective methods that determine cost, schedule, and other impacts of user change requests. Frequent processing of user requested changes provides experience to the project manager who could become an expert. This processing starts when the request is first identified and ends when the request is incorporated in the construction project.

The Sample. Stone writes that research can include hand picked elements in the sample (called purposive sampling), provided the sample is satisfactory considering the needs of the study (34:81). This research employs purposive sampling because of the need to interview "experts" who employ methods that successfully evaluate impacts of user change requests. The sample can be considered hand picked because the researcher selected two of the four AFRCEs and a single MAJCOM to provide the

sample elements. In turn, the engineering design and/or construction management supervisors at these offices selected qualified project managers for the interviews.

The AFRCE and MAJCOMs typically have the largest concentration of design construction project managers at a single location. This concentration provided a logistical advantage (e.g., saves travel time) for the research.

Data Gathering Process. Stone writes that interviews consist of the researcher presenting the questions and recording the elicited responses (34:67). The elicited responses are in Appendix B. Sometimes the interviewees discussed examples or information not relevant to the research. This information is not in Appendix B.

This research consisted of semi-structured interviews that involve face-to-face interaction or the use of the telephone. In a semi-structured interview (or sometimes called an open-ended interview), the respondent can "answer a predetermined set of questions in any manner he or she chooses" (34:68). The semi-structured interviews consisted of questions allowing for some dichotomous responses (e.g., yes or no), and open-ended questions allowing the interviewee to answer any way they choose (34:68). These open-ended questions can be used when the nature of the research is to discover opinions and degrees of knowledge (21:217).

This data gathering format applies to developing a hypotheses rather than testing of a hypothesis (34:68).

The objective of this research is to identify effective methods to evaluate user change requests in design or construction; the objective is not to test any specific model used to evaluate change requests.

Stone also points out that the interviewing technique ". . . may not lead to as thorough an understanding of the phenomenon under investigation as alternative data collection methods . . ." (34:69). For example, he states that sometimes the interpersonal nature of the interview process may influence the interviewee attitudes (34:69). The researcher tried to avoid this and other common pitfalls.

The researcher conducted face-to-face interviews. Experience shows that these interviews, held in a relaxed environment, promote the interviewee to open up and discuss the topic (21:217-218). This open environment provided the researcher the opportunity to probe over the responses. Zeisel states that during an interview a problem could occur because the respondent thinks he is providing a satisfactory answer, while the researcher may not consider his answer satisfactory. Probing can be accomplished through cross-examination. Zeisel points out that the interviewer lacks the legal authority of an attorney, thus this research must employ tact and psychological empathy (39:172). Zeisel states "The general rule for probing is to recognize that the final choice is the end point of a funnel of successively narrowing alternatives" (39:174).

Fifth Stage. Zeisel states that after the interviewing is done, the fifth and last stage of the reason analysis is the task of counting and summarizing (39:182). Kadushin states that this stage is the most difficult part of a reason analysis because assessment of cause and meaning must be performed (24:341).

To begin the analysis, the questionnaire results are tabulated. A large number of "no answers" to the questionnaire used in this research would reflect unsuccessful or unsystematic interviewing (39:182).

Kadushin states that causes cannot be assessed by comparing actors to nonactors. This means effective methods of evaluating user change requests can not be determined by comparing responses of project managers who effectively manage user change requests to project managers who do not effectively manage user change requests. The following three strategies are possible to assess cause: (1) get the actor to do so, (2) use the clinical judgement of the researcher, and (3) reduce the number of factors into a smaller set (24:340).

The researcher will use the second and third strategies from above (i.e., rely on personal judgement and reduce the factors into a smaller set). The data analysis will include developing an understanding of the key factors in the evaluation of change requests. A frequency analysis will be used to identify key factors and key decision-making points. The researcher will use these factors and

decision-making points to determine if they can be arranged in a useful format for project managers. One useful format is the flowchart.

Lucas in his book, Information Systems Concepts for Management, states that flowcharts are a graphical technique that facilitate design in an information system (25:307). Also, he states that flow charts depict the following: (1) knowledge and decision rules, and (2) where the data is created and manipulated in processing information (25:429,310). If the factors cannot be arranged in a flow chart format, then the possibility of using a checklist will be examined.

Chapter Summary

This research employs a reason analysis methodology to assess causes of project managers actions when evaluating user change requests in design and construction. Reason analysis will be used to establish a hypothesis and assess "reasons for," rather than the testing a specific hypothesis.

Reason analysis consists of five stages. These stages are the following: (1) select boundaries to the research, (2) select the actions to investigate, (3) develop an accounting scheme, (4) conduct actual interviews, and (5) analyze the data.

Development of the accounting scheme is a critical stage. An accounting scheme provides the structure for the

questionnaire. This questionnaire was pretested three times before the data collection stage.

The researcher will conduct interviews with project managers at two AFRCEs and one MAJCOM. The research will consist of face-to-face and telephone interviews in a semi-structured format. The semi-structured format allows the interviewee to respond to a predetermined set of questions any way they choose. This open environment also allows the researcher to "probe" over the interviewee responses.

Next Chapter of Thesis

Chapter IV (Results) presents the information collected during the interviews. These results form the basis to develop conclusions in later chapters.

IV. Results

Chapter Overview

The purpose of this research is to identify procedures that design and construction project managers can use to evaluate user requested changes. These changes will help acquire quality facilities to enhance user productivity. But the project manager must balance quality to project execution (on time and within available resources).

This chapter presents the results of the data gathering process as described in Chapter III. The percentages and frequency counts of the interview responses are the basis from which the data analysis and conclusions are developed in Chapters V and VI, respectively.

This chapter is divided into two parts. The first part describes the demographics of the research interviews. The second part, which is the major part of this chapter, reports the interviewee responses to the six investigative questions posed in Chapter I.

Distribution of Interviewees

The research includes a total of 27 interviews. Their responses are provided in Appendix B. To safeguard the anonymity of all interviewees, the researcher omitted any name references to the source of Appendix B data. A summary of the interviewee demographics is the following:

Location	Number interviewed
AFRCE - Central Region	11
Headquarters SAC/DEE	12
AFRCE - Ballistic Missile Support	4
Total	27

The research eliminated 1 of the 27 interview responses because this interviewee lacked experience in evaluating user change requests. The remaining 26 interview responses are the basis for this chapter's percentages and frequency counts.

The research questionnaire included two types of interview questions. The first type is a structured question, typically answered by either "yes" or "no." The second type is an open-ended question.

The responses for the structured interview questions could be summed fairly easily, except when the interviewees answered with a qualified "yes" or "no." Summing the responses to the open-ended questions was more difficult. The researcher abbreviated some of these responses to tabulate the main ideas in a frequency analysis.

Characteristics of the Questionnaire Responses

Research Question 1. Research question 1 is "What factors should be used to evaluate change requests?" Interview Questions 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3i, 3j, 3k, 3l, 3m, 7e, and 7f of the questionnaire address this

research question. The responses to these interview questions are discussed below.

Interview Questions 3a and 3c. These questions were designed to identify the percentage of interviewees who were familiar (i.e. had a working knowledge) with Air Force guidance on evaluating user change requests. Table 4.1 presents the percentages of personnel familiar with the two most recent versions of AFR 89-1.

Table 4.1

Percentages of Interviewees Aware of Guidance in 20 Jun 78 and 1 Nov 88 Versions of AFR 89-1

AFR 89-1 Version	Familiar	Percent	Not Familiar	Percent
20 Jun 78	22	84.6	4	15.6
1 Nov 88	20	76.9	6	23.1

The slightly lower percentage for the newer version of AFR 89-1 suggests that some interviewees have not reviewed this newer version because of its relatively recent publication. Some interviewees also stated that they were aware of, but had not seen, the new version of AFR 89-1.

Interview Questions 3d and 3e. For those respondents familiar with the outdated version of AFR 89-1, the questionnaire asked did they follow the regulation's

guidance (Interview Question 3d) and what specific guidance (Interview Question 3e) did they follow. Table 4.2 presents the percentages of those 22 interviewees identified in Table 4.1 (familiar with the outdated version) who followed the guidance in the 20 Jun 78 version of AFR 89-1.

Table 4.2

Percentages of Interviewees Who Followed Guidance in the 20 Jun 78 Version of AFR 89-1

Response	Count	Percent
Followed guidance	16	72.7
Did not follow guidance	6	27.3

Table 4.3 presents a frequency count of the various items of specific guidance that the 22 interviewees followed from the 20 June 1978 version of AFR 89-1.

Table 4.3 indicates that the most frequent response of respondents who followed the previous version of AFR 89-1 is that the interviewees could not recall any specific guidance they followed.

Table 4.3

Frequency Table for Specific Guidance Followed from the 20 Jun 78 Version of AFR 89-1

Response	Count	Percent
Approval process to handle modifications	3	13.6
Funding guidance	2	9.1
Correspondence with other agencies	1	4.5
Determination of mission essentialness	2	9.1
Timely implementation	1	4.5
Could not recall specific criteria	7	31.2

Interview Question 3b. This question asked those 20 respondents familiar with the current version of AFR 89-1 (from Table 4.1) how much guidance this version provided as compared to other sources when evaluating user requested changes. Respondents selected from one of four possible choices: (1) large amount, (2) fair amount, (3) small amount, or (4) none of the interviewee's guidance. Table 4.4 presents the percentages of the interviewees responding to each choice.

Table 4.4 indicates that the current version of AFR 89-1 provides little or no guidance to three-quarters of the interviewees. Perhaps an explanation is that the

Table 4.4

1 Nov 88 Version of AFR 89-1 Guidance Amounts to Interviewees

Response	Count	Percent
Large amount of guidance	1	5
Fair amount of guidance	4	20
Small amount of guidance	12	60
No guidance	3	15

current version of AFR 89-1 ". . . gives increased flexibility to the MAJCOMs for design and construction of their programs [design and construction management]. . . ." (11:24).

Table 4.4 shows the need to ask design and construction project managers what factors they use to evaluate user requested changes. Interview Questions 3f and 3g gather data on these additional factors.

Interview Questions 3f and 3g. These questions asked the interviewee if they use any additional factors (Interview Question 3f) and to identify these factors (Interview Question 3g).

The respondents could select from one of two choices (either yes or no) for Interview Question 3f. All 26 interviewees said "yes" that they use additional factors, other than AFR 89-1, to evaluate user requested changes. A

very high percentage is expected because Table 4.4 shows that three-fourths of the interviewees stated that the current version of AFR 89-1 provides little or no guidance to evaluate user requested changes.

Appendix C presents a frequency count of the various additional factors (Interview Question 3g) the 26 interviewees use to evaluate user requested changes. The total of the factor counts (118) is greater than 26 because some interviewees stated 9 or 10 different factors.

Besides the 48 factors of Appendix C, the interviewees may want to use other factors to evaluate user change requests. However, one reason or another may prevent the interviewee from using these other factors. Interview Questions 31 and 3m ask the interviewee for these other factors.

Interview Questions 31 and 3m. These questions asked the interviewee the following: (1) if other factors, currently not in use, are needed to evaluate requests (Interview Question 31); and (2) what are these factors (Interview Question 3m).

The interviewees could select from one of the two choices (either yes or no) in Interview Question 31. Table 4.5 presents the percentages of the 26 interviewees who felt other factors should be used to evaluate user requested changes.

Table 4.5 indicates a low percentage of the respondents feel other factors (besides those currently in

Table 4.5

Percentages of Interviewees Who Feel Other Factors Should Be Used to Evaluate Requests

Response	Count	Percent
Additional factors should be used	6	23
Additional factors should not be used	20	77

use) are necessary to evaluate user requested changes. Table 4.6 is a frequency count of the various additional factors from the six interviewees who said additional factors should be used to evaluate these requests.

From the lists in Appendix C and Table 4.6, the researcher asked the interviewee to identify those factors that changed the original user request. Interview Questions 7e and 7f gather data in this area.

Interview Questions 7e and 7f. These questions asked if the interviewee ever revised a user requested change (Interview Question 7e) and what circumstances caused this revision (Interview Question 7f).

Table 4.6

Frequency Table for Other Factors that Could Be Used to Evaluate User Requests

Response	Count	Percent
Exclude politics	1	16.7
Guidance from AFR 89-1	1	16.7
Changing the Form 1391 criteria	1	16.7
Verified mission essential by MAJCOMS	1	16.7
Exclude personal preferences	2	33.3

Table 4.7 presents the percentages of the 26 respondents involved with user requested changes that required a revision. The interviewees could select from one of two choices (either yes or no) in Interview Question 7e.

Table 4.7 indicates that a very high percentage of the interviewees were involved with revisions to the original request. Interview Question 7f asks the 25 interviewees for the circumstances that caused this revision.

Appendix D lists the 24 circumstances that caused the interviewees to revise to the original user request, and the frequency count for each circumstance. The sum of the counts for all requests is greater than 25 because some interviewees stated 4 or 5 circumstances.

Table 4.7

Percentages of Interviewees Who Handled

Changes to the User Requested Changes

Response	Count	Percent
Have been involved with changes to the changes	25	96.1
Have not been involved with changes to the changes	1	3.9

Appendix D indicates that the three most frequent circumstances include the following: (1) funds availability, (2) bad information about the requested change, and (3) the requested change was not in the project scope. These factors listed in Appendix D may require special attention when evaluating requested changes. Chapter V compares these factors to the list from Interview Question 3g.

Interview Questions 3i, 3j and 3k. These questions were designed to identify the following:

1. The percentages of interviewees with factors (from Interview Questions 3g) that are officially approved (Interview Question 3i).

2. Who approved those factors (Interview Question 3j).

3. Prior to approval, who did the interviewee discuss or coordinate their factors with (Interview Question 3k).

The respondents could select from one of two choices (either yes or no) in Interview Question 3i. Table 4.8 presents the percentages of the 26 interviewees who state that their factors have been officially approved.

Table 4.8

Percentages of Interviewees Whose Evaluation Factors Have Been Officially Approved

Response	Count	Percent
Factors have not been officially approved	17	65.4
Factors have been approved on certain projects	5	19.2
Factors have been officially approved	4	15.4

Table 4.8 indicates that a low percentage of interviewees' factors have been officially approved. The next logical question is Interview Question 3j, which asks those four interviewees with officially approved factors about the approval of their factors. Table 4.9 represents the responses of these four interviewees. Interview Question 3j is an open-ended question.

The researcher summarized and grouped these responses into the categories as shown in Table 4.9. The researcher believes that there is not enough information to further

Table 4.9

Frequency Count of Approval Authority on the Interviewee Factors to Evaluate User Change Requests

Response	Count	Percent
Someone in the interviewees chain-of-command	3	75.0
Facility change board	1	25.0

analyze this aspect of evaluating user requested changes. Thus, this chapter contains no analysis to Interview Question 3k (who did the interviewee discuss or coordinate their factors with, prior to the approval).

Research Question 2. Research question 2 is "How should the evaluation factors vary in different stages of the design and construction phases, if at all?" Interview Questions 4a and 4b address this research question. The responses to these interview questions are discussed below.

Interview Question 4a. This question asks the interviewees if their factors to evaluate user requested changes differ when the project is in design, at contracting, or under construction. Table 4.10 presents the percentages of the 26 interviewees whose factors differ in the various stages of the MILCON process.

Table 4.10

Percentages of Interviewees with Factors to Evaluate Requests that Vary Between the Design, Contracting

Response	Count	Percent
Factors differ	22	84.6
Factors do not differ	4	15.4

Table 4.10 indicates that most respondents stated their evaluation factors differ between the project design, contracting, and construction phases. The next interview question asks the interviewees to describe these differences.

Interview Question 4b. This open-ended question asked those 22 who responded "yes" to Interview Question 4a to identify those different factors used in either design, at contracting, or under construction. Appendix E presents the frequency counts of the various differences. The researcher summarized some of the responses to allow tabulation of the main idea in a frequency analysis.

Appendix E indicates the most frequent response is that the project manager has more flexibility to accommodate changes in design (because of less costs involved) versus contracting or construction phases. The next most frequent response is that while the project is at contracting, a key concern is to balance the request with

awarding the project in the current fiscal year. The researcher grouped the responses into 12 different items. The total of the responses is greater than 22 because some interviewees provided 2 or 3 responses.

A comparison of Appendix E to Appendix C reveals that not one of the interviewees responded with a "varies based on the project phase" factor to Interview Question 3g (the factors used to evaluate the requests). Perhaps the interviewees felt this factor was to broad a response for Interview Question 3g.

Research Question 3. Research question 3 is "How should the factors be weighed to evaluate user requested changes?" Interview Questions 5a and 5b address this research question. The responses to these interview questions are discussed below.

Interview Question 5a. This structured question asks the interviewee to rate their responses from Interview Question 3g. Interview Question 5a asks the interviewee about the importance of each evaluation factor when evaluating a user change request. The interviewee could select from one of three following choices: (1) the specific factor is either important, (2) moderately important, or (3) not-to-important. Appendix C presents the frequency counts of the three choices for each factor.

The 26 interviewees selected choices for 116 of the total of 118 factors from Interview Question 3g. The difference is because an interviewee responded "varies" for

two factors, which could not be grouped into any of the three choices. Table 4.11 summarizes the frequency counts of the three choices.

Table 4.11

Frequency Count of Individual Factors Versus Importance of that Factor

Response	Count	Percent
The factor is important	87	75.0
The factor is moderately important	25	21.6
The factor is not-too-important	4	3.4

Appendix C indicates the interviewees feel most of their factors are important. Fourteen of the 48 factors in Appendix C are used by three or more respondents. For only one (life cycle cost or economic analysis) of these 14 factors did the interviewees more frequently select responses in either the "moderately important" or "not-too-important categories." For the remaining 13 factors, the majority of interviewees selected the "important to know" response.

Interview Question 5b. This structured question uses the interviewee factor responses from Interview Question 3g. The question asks the interviewee about the

degree of difficulty to obtain an answer to each factor. The interviewee could select from one of three following choices: (1) the specific factor is either easy, (2) moderately difficult, or (3) difficult. Appendix C presents the frequency counts of the three choices for each factor.

The 26 respondents selected choices for 116 of the total of 118 factors from Interview Question 3g. The difference is because an interviewee responded "varies" for two factors, which could not be grouped into any of the three choices. Table 4.12 summarizes the frequency counts of the three choices.

Table 4.12

Frequency Count of Individual Factors Versus Degree of Difficulty of that Factor

Response	Count	Percent
The factor is easy to answer	58	50.0
The factor is moderately difficult to answer	38	32.8
The factor is difficult to answer	20	17.2

Table 4.12 shows the responses are more evenly distributed than from Table 4.11. The interviewee responses indicated that for approximately half of the

factors, the interviewees felt that factor is easy to answer.

For 6 of the 14 factors with three or more respondents, a majority stated that it would be easy to obtain an answer to that factor. These factors include the following: (1) funds availability, (2) is change in scope (legal), (3) MAJCOM opinions, (4) benefits to the Air Force or government, (5) identifying if the change makes the facility "complete and usable", and (6) a technical evaluation of the change. For 3 of the 14 factors with three or more respondents, a majority stated that it would be moderately difficult to obtain an answer to that factor. These factors include the following: (1) is the request a want or need, (2) schedule impact, and (3) cost determination of the request. For 2 of the 14 factors with three or more respondents, a majority stated that it would be difficult to obtain an answer to that factor. These factors include the following: (1) is the change valid, and (2) a functional benefit to the user. The remaining 3 of the 14 factors shows a tie between the easy and moderately difficult responses ((1) determining the impact to mission or mission essentiality); or a tie between the easy, moderately difficult and difficult responses ((2) life cycle costs, and (3) are other options available).

Research Question 4. Research question 4 is "What formal procedures should the project manager follow to process the change request?" Interview Questions 6a, 6b,

6c, 6d, 6e, and 6f of the questionnaire address this research question. The responses to these interview questions are discussed below.

Interview Questions 6a and 6b. These questions ask the interviewees if they work on projects that require formal approval on user requested changes (Interview Question 6a) and for a description of this formal approval process (Interview Question 6b).

The respondents could select from one of two choices (either yes or no) in Interview Question 6a. Table 4.13 presents the percentages of the interviewees who stated that the requested change requires formal approval.

Table 4.13 indicates that most respondents work on projects that require formal approval. Open-ended Interview Question 6b asks the interviewee to describe this formal approval process.

Table 4.13

Percentages of Interviewees that Work with Changes that Require Formal Approval

Response	Count	Percent
Requests require formal approval	22	85.6
Requests do not require formal approval	2	7.7
Request approval depends on situation	2	7.7

Appendix F presents a frequency count of the various formal approval processes. These responses are from the 24 interviewees who work with requests that either require formal approval, or the situation dictates that the requests require formal approval.

Appendix F indicates that the most frequent response is the basic approval process includes the user forwarding the request to the base; once approved, the request is sent to the MAJCOM; and if approved, the request is then sent to the AFRCE. One reason for the most frequent response is the current version of AFR 89-1 states "The requiring MAJCOM validates and approves user change requests. . . ." (11:9). Although AFR 89-1 also allows the MAJCOMs to delegate some or all user change request authority. Three of the interviewees identified this delegation process. The next most frequently identified approval process is to discuss the requested change at regularly held meetings with all the project players present. One of the interviewees responded that the most effective meetings are run by a senior officer from an office that develops project requirements, and has close ties with the installation wing commander.

The next step of the research was to determine if any documents exist that describe this formal process. Interview Questions 6c and 6d address this area.

Interview Questions 6c and 6d. These questions ask the 24 respondents, whose evaluation procedures include

formal approval on requested changes, if a document exists that describes this process (Interview Question 6c) and to describe this document (Interview Question 6d).

The interviewees could select from one of two choices (either yes or no) in Interview Question 6c. Table 4.14 presents the percentages of the 24 interviewees who said a document describes a formal approval process.

Table 4.14 indicates that most interviewees work with changes that require formal approval, as spelled out in a document. The next logical question is to identify this document.

Table 4.14

Percentages of Interviewees Using Formal Approval Processes Described in a Document

Response	Count	Percent
A written document exists	19	79.2
A written does not exist	5	20.8

Table 4.15 presents the responses by the 19 interviewees, who work with requests require formal approval, to the open-ended Interview Question 6d. This table shows the frequency count of the various documents that describe the formal approval process.

Table 4.15 indicates that the most frequent response, as mentioned by two-thirds of the interviewees, is either individual project management plans or AFR 89-1. The sum of the counts is greater than 19 because some interviewees provided 2 responses.

The next item of the research is to determine the similarities and differences of these policies.

Table 4.15

Frequency Count of the Written Documents that Establish the Formal Written Approval Process

Response	Count	Percent
Individual project management plans	9	37.5
AFR 89-1	7	29.2
Project managers handbook	3	12.5
Could not recall specific plan	5	20.8
Operating Instructions	1	4.2

Interview Questions 6e and 6f. These questions ask the interviewee if the approval policies differ on different projects (Interview Question 6e) and what are these differences (Interview Question 6f).

Table 4.16 presents the percentages of the 26 respondents who identify that approval policies differ on

different projects. The interviewees could select from one of two responses, either "yes" or "no".

Table 4.16 shows no majority exists, among the respondents, on whether approval policies differ on different projects.

Table 4.16

Percentages of Interviewees Who Identify that User Requested Change Approval Policies Differ on Different Projects

Response	Count	Percent
Approval policies do not vary based on project	13	50.0
Approval policies do vary based on project	13	50.0

Table 4.17 presents a frequency count of these differences in approval policies of the 13 respondents who answered "yes" to Interview Question 6e. Table 4.17 indicates the most frequent response is that the approval policy depends on who the user is and who is driving the request.

Research Question 5. Research question 5 is "What types of organizations should the user change request be coordinated with?" Interview Questions 7a, 7b, 7c, and 7d

address this research question. The responses to these interview questions are provided below.

Table 4.17

Frequency Count of Differences in Approvals of User Requested Changes

Response	Count	Percent
Who user is and who is driving request	4	30.8
Varies based on project	3	23.1
Cost of change determines approval authority	3	23.1
Differences spelled out in management plan	3	23.1

Interview Questions 7a, 7b and 7c. These questions accomplish the following:

1. Identify the percentage of interviewees who state that requested changes are coordinated with third agencies (Interview Question 7a).

2. Report the percentage of interviewees who state coordination is obtained from all agencies involved with the project (Interview Question 7b).

3. Identify what agencies are typically coordinated with (Interview Question 7c).

The respondent could select from one of two choices (either yes or no) in Interview Question 7a. All of the 26

interviewees said "yes" that the user requested change is coordinated with third organizations. A very high percentage is expected to respond "yes" because AFR 89-1 emphasizes the coordination process (11:16).

The interviewees could select from one of two choices (either yes or no) in Interview Question 7b. Table 4.18 presents the percentages of the 26 interviewees who stated that the changes are coordinated with all agencies involved with the project.

Table 4.18

Percentages of Interviewees Who Work on Projects Where Requested Changes Are Coordinated with All Agencies Involved with the Project

Response	Count	Percent
For each request coordination is obtained from all agencies	17	68.0
For each request coordination is not obtained from all agencies	8	32.0

A few of the interviewees pointed out that they assumed "all agencies involved" to mean "all applicable agencies." This was a correct assumption. Two of the interviewees also stated that all agencies were at least notified of the request, and the agencies' responsibility included notifying Civil Engineering of any impacts on

their organization. The researcher included these responses in the category of "coordination is obtained from all agencies."

Table 4.19 presents a frequency count of the agencies that are typically coordinated with. The researcher summarized and grouped the interview responses into the categories shown in Table 4.19. The interviewees who responded "no" to Interview Question 7b provided responses in Table 4.19. Although some of the interviewees who responded "coordination is obtained from agencies" answered

Table 4.19

Frequency Count of the Agencies Typically Coordinated with on a Requested Change

Response	Count
Design and construction agent	2
Agencies that have a need to know	5
Base level organizations (outside civil engineering)	7
Organizations within base civil engineering	3
Organizations within the MAJCOM	2

Interview Question 7b anyway. The researcher believes that confusion existed among some respondents over the general set-up of this group of interview questions.

Table 4.19 indicates the most frequent response is coordination of the user requested change is with base level agencies outside civil engineering. This is what can be expected because most of the organizations impacted by a change request are on the installation.

The next logical question is to ask how is this coordination obtained from the agencies involved with the project. Interview Question 7d addresses this area.

Interview Question 7d. This open-ended question asked the interviewee how they coordinate the request with other agencies.

Table 4.20 presents a frequency count of the various coordination methods as stated by the 26 respondents.

Table 4.20

Frequency Count of the Various Methods to Obtain Coordination from Outside Organizations

Response	Count	Percent
Discussion over the phone	11	42.3
In writing	11	42.3
At meetings	4	15.4
Organizations sign off on form letter	3	11.5
Phone calls, followed up by a letter	2	7.7
Others do coordination	2	7.7

Table 4.20 indicates the two most frequent responses are that the interviewees obtain coordination by either the phone or in writing. The sum of the counts for all responses is greater than 26 because some interviewees provided 2 responses.

Research Question 6. Research question 6 is "Do any existing decision support systems address how to evaluate requested changes?" Interview Question 3h addresses this research question. The responses to this open-ended interview question is provided below.

Interview Question 3h. This question asked the 26 respondents about the organization of their factors (from Interview Question 3g). Table 4.21 presents the frequency count associated with each response.

Table 4.21

Frequency Count of Various Methods to Organize the Factors Used to Evaluate User Requested Changes

Response	Count	Percent
No formal organization	19	73.1
Personal i' .itive process	3	11.5
Project books	2	7.7
Situation dictates	1	3.8
Operating instruction	1	3.8

Table 4.21 indicates that the vast majority of interviewees (with responses of "no formal organization" or "personal intuitive process") do not have their factors organized in a decision support system (e.g., checklist or flowchart). A few of the interviewees stated that the process to evaluate user requested changes does not lend itself to a checklist that could cover all situations. The researcher pointed out that developing a checklist to cover all situations is not necessarily a goal of this research.

Chapter Summary

Through the use of tables, this chapter presents the percentages and frequency counts of the interviewee responses. This chapter also grouped all interview questions with the corresponding research question.

Most of this chapter's results address the first research question. This effort shows the factors the interviewees use to evaluate user requested changes. Most of these factors are gained through individual experience, and not from a regulation. Also, most interviewees were involved with revisions to the original change requests.

Other tables in this chapter identify that most interviewee factors differ in different phases of the project, and address the formal approval process of the user change request. Most interviewees stated that a written document exists to identify that formal approval process. About half on the interviewees stated that the

approval policies on user requested changes varies by project.

Next Chapter of Thesis

Chapter V (Analysis and Discussion) analyzes the research data from the summary tables and appendices. Various tables are compared and contrasted to form the basis for the conclusions and recommendations developed in Chapter VI (Summary and Recommendations).

V. Analysis and Discussion

Chapter Overview

This chapter is divided into two sections. The first section discusses the completed and remaining stages of the "reason analysis" methodology in this research. The second section analyzes the interview data to address each of the research questions from Chapter I.

Employing the Reason Analysis

As stated in Chapter III, the reason analysis consists of five stages. The first stage of this research created the six research questions posed in Chapter I. The second stage allowed the researcher to gain some insight into understanding how user change requests should be evaluated by conducting the literature review in Chapter II. Time limitations forced the researcher to combine a large part of the second stage with the third stage (development of the accounting scheme). The questionnaire in Appendix A represents the accounting scheme to address effective decision-making procedures on user requested changes. The fourth stage is conducting the interviews. The results are in Appendix B. The fifth and final stage is the counting and summarizing to assess cause and meaning of actions. Chapter IV provides the initial summaries of data. However, Zeisel states that "By relating the answers in one dimension to those from ancther dimension, new insights can

be gained" (39:183). The remaining portion of this chapter relates the responses of different questions to look for new insights to address the research questions.

Research Questions 1 and 3

Research question 1 is "What factors should be used to evaluate change requests?" Research question 3 is "How should these factors be weighed to evaluate user requested changes?" Research question 3 closely follows research question 1, therefore these questions are grouped in a single discussion.

The first place to look for policy and guidance is in the regulations. Table 4.4 indicates the current version of the AFR 89-1 provides little or no guidance to the interviewees. Also, Table 4.3 indicates that most of the interviewees stated that they could not recall the guidance they followed from the previous version of AFR 89-1. Hence the need to ask the project managers for their factors gained from experience in evaluating requests.

Appendix C lists the 48 factors that the interviewees use to evaluate requested changes. This list is much larger than the evaluation factors provided in either the previous or current version of AFR 89-1.

Appendix C indicates the five interviewee factors used most often include the following: (1) the cost of the request, (2) the schedule impact, (3) the funds availability, (4) determining if the request is a want or

need, and (5) determining the impact to the mission. Either or both versions of AFR 89-1 identify the factors with the five highest frequency counts. The previous and current versions of AFR 89-1 state to consider funds availability when evaluating a request. The previous version of AFR 89-1 states to examine the schedule impact before implementing a requested change. Both versions of AFR 89-1 include the factors "is the request a want or need" and "impact to the mission or mission essential."

Table 4.5 leads the researcher to believe most interviewees currently use the factors that are necessary to evaluate the requested changes. Project managers then operate with the flexibility and freedom to evaluate the requests. No particular individual or organization would tell a project manager to "overlook" certain factors when evaluating a request. However, most of the other factors in Table 4.6 (e.g., exclude politics, exclude personal preference, and changing the Form 1391 criteria) are very difficult to exclude or include as factors. Then the list of Appendix C contains the most "practical" factors to evaluate user requested changes.

The researcher divided the 48 factors of Appendix C into the following three classifications: (1) attributes, (2) influences, and (3) predispositions. As stated in "Questionnaire Drafting" Section of Chapter III, these three classifications represent the reasons why people do

things the way they do. This is important in the "art of asking why."

Appendix G presents the factors grouped into one of the three classifications. Most of the 48 factors fall into the attribute classification (20 total count) or influence classification (21 total count). The remaining seven factors fall into the predispositions classification. This indicates that upon receiving a requested change, a project manager would think more often about the "attributes" of the request and "influences" upon the individual rather than their "predispositions."

Also, Appendix G divides the "attributes" and "influences" into factors associated with either the "quality of the facility" or "execution of the project." Some factors could not be grouped into the either "quality" or "execution" categories. The researcher refers to these as "others" in Appendix G. The "others" category typically refers to opinions of various agencies or individuals.

Table G.1 shows that the "execution" and "quality" frequency response counts are nearly equal (36 versus 32), in the "attribute" classification. However, in the "influence" classification the execution factors outnumber the quality factors (19 to 10). This indicates that external sources influence project managers more towards the project execution concerns rather than the quality of the facility when evaluating a request.

Table G.1 also contains the "Count and Importance Degree" score for each factor. The "Count and Importance Degree" is obtained by multiplying the frequency of each response by the importance factor of that response (an "important" response is worth three points, a "moderately important" response is worth two points, and a "not-too-important" response is worth one point). Higher scores represent factors used more often and rated more important by the interviewee.

Appendix G indicates that a factor with a "High Frequency Response Count" also has a high importance score. The "cost of request" factor, with the "Highest Frequency Count," had the highest "Count and Importance Degree" score. The next four highest "Frequency Response Count" factors (schedule impact, funds availability, impact to the mission or mission essential, and is the request a want or need) also received the next four highest "Count and Importance Degree" scores. This would be normally expected since the more the project manager uses a factor, the more importance would be placed on that factor.

To determine the degree of linear association between the "Frequency Response Count" and "Count and Importance Degree," the researcher entered these scores into the Simple Correlation subprogram of the Statistix microcomputer analysis program. The results are in Appendix H. From Appendix H, "Count" represents the "Frequency Response Count" score, and "Import" represents

the "Count and Importance Degree" score. The Statistix computed correlation coefficient was .9889. This indicates a strong positive linear relationship between "Frequency Response Count" and "Count and Importance Degree" scores. This correlation score leads the researcher to conclude that the more the particular factor is used, the more importance the project manager places with that factor.

Each factor also has a corresponding "Weighted Difficulty Average" value. The "Weighted Difficulty Average" is obtained by averaging the degree of difficulty scores for each response (an "easy" response is worth one point, a "moderately difficult" response is worth two points, a "difficult" response is worth three points). Higher scores represent an increased difficulty to address that particular factor. All scores range between the values of one and three.

To determine the degree of linear association between the "Frequency Response Count" and "Weighted Difficulty Average," the researcher entered these scores into the Simple Correlation subprogram of the Statistix microcomputer analysis program. The results are in Appendix H. From Appendix H, "Count" represents the "Frequency Response Count" score, and "Diff" represents the "Weighted Difficulty Average" score. The Statistix computed correlation coefficient was negative .0203. This indicates strong evidence of the lack of a linear relationship between "Frequency Response Count" and

"Weighted Difficulty Average" scores. This correlation score leads the researcher to conclude that the degree of difficulty of an evaluation factor has little bearing on a project manager's use of that factor.

The research also compares the reasons to revise the original change (Appendix D) to the list of factors in Appendix C. Eight factors appear on both lists. These factors include the following: (1) constructability, (2) maintenance of real property, (3) is the request legal, (4) how urgent is the request, (5) impact to the mission or mission essential, (6) funds availability, (7) technical evaluation, and (8) a great idea at the wrong time. Project managers should be aware of these evaluation factors (particularly of the "funds availability" and "is the request in scope or legal" factors because of their high frequency counts) because they could revise the original requested change.

Sixteen of the 24 circumstances listed in Appendix D do not appear in Appendix C. At first glance, one could believe the list in Appendix C is not complete since these circumstances in Appendix D influenced the requested change. However, these 16 circumstances could help explain the reason for the requested change. (Further study must confirm this). Table I.1 of Appendix I divides these 16 circumstances into the following three classifications: (1) early indicators of future requests, (2) misunderstandings, and (3) poor staff work.

Project managers would benefit if they understood these circumstances could become traps during the conceptual design phase. If misunderstandings and poor staff work occurs during the conceptual design phase, then probably the project manager will evaluate more than a "fair share" (from information that no one has control over) of user requests in the final project design and construction project phases.

From Table 4.8, most interviewees' factors have no official approval by anyone or any organization. This leads the researcher to believe the project manager acquires factors through experience. This probably contributes to the Air Force project execution problems if inexperienced personnel manage the project. Appendix I could help these inexperience personnel quickly gain the experience of others.

Research Question 2

Research question 2 is "How should the evaluation factors vary in different stages of the design and construction phases, if at all?"

From Table 4.10, most of the interviewees stated that their evaluation factors vary between the project design, contracting, and construction phases.

From Appendix E, the most frequent response was that the project manager has more flexibility to accommodate the change in design versus when the project is at contracting

or under construction. Some of the interviewees summarized the process by stating that during design the project manager considers just milestone impacts; however, in construction, the project manager must consider both milestone and cost impacts. This response indicates that the project manager's predispositions towards the request do not change. For the later project phases, the project managers' external environment increasingly dictates the change approval process. The project manager has little control over this operating environment.

To address research question 2, the project managers' evaluation factors remain the same in the different project phases. Only the external operating environment increases the difficulty of incorporating a requested change in the later project phases. A project manager must increase the scrutiny the later the user submits the request.

One interviewee stated the smart project manager expecting future requests in the later phases of the project will build flexibility into the early stages (e.g. design) and not cut costs to the minimum, if possible. This represents one way the project manager could increase the flexibility of their operating environment.

Research Questions 4 and 5

Research question 4 is "What formal procedures should the project manager follow to process the change request?" Research question 5 is "What types of organizations should

the user request be coordinated with?" Research question 5 closely follows research question 4, therefore these questions are grouped into a single discussion.

Table 4.15 and Appendix F show that for a majority of the interviewees, the formal approval process on requested changes follows the guidance in AFR 89-1, either directly or indirectly by a project management plan. The literature review in Chapter II provides some examples of management plans that address how to evaluate user requested changes. These plans typically address evaluation of requests on a single page.

Table 4.15 shows that a substantial number (five) of interviewees could not recall the specific plan that describes the formal written approval process. An initial impression is that if an individual does not even know the name of a plan, then how could that individual know about the contents of the plan. However, without further questioning, a conclusion cannot be developed. The interviewee may not have worked with the plan for a few years.

The researcher compared Table 4.15 to Table 4.4 (where five of the interviewees stated that AFR 89-1 provides a large or fair amount of their guidance). None of these five interviewees said that they follow the AFR 89-1 approval process on requested changes. Although, these interviewees may have been thinking of other factors as to

why AFR 89-1 provides a large or fair amount of their guidance.

The formal approval process also includes the coordination of a change request. All interviewees responded that the change requests are coordinated with organizations other than the one requesting the change. The purpose of this interview question was to determine how much coordination is sufficient. From Table 4.18, most of the interviewees will obtain coordination from all agencies involved with the project. From Table 4.20, the most popular methods of coordination are by the telephone and by correspondence.

From Table 4.19, if the project manager does not coordinate with all agencies, then ones most likely coordinated with are the installation agencies outside of base civil engineering. This sounds reasonable because most agencies impacted by a requested change would be on the installation. The researcher could not find a consistent relationship between projects where each request is not coordinated with all agencies (Table 4.18) to the method of coordination (Table 4.20).

Research Question 6

Research question 6 is "Do any existing decision support systems address how to evaluate requested changes?"

The research did not find any decision support systems that address evaluation of requested changes. Table 4.21

indicates that most interviewees stated evaluating user change requests is an intuitive process rather than a formal process. This provides evidence that a limited amount of research exists or is distributed in this area.

The lack of any decision support system in use is probably bad for the entire Air Force, as identified from the problems stated in Chapter I. The researcher realizes that extracting knowledge from an expert is not easy. To show any benefits from such a decision support system would be more difficult.

A decision support system could provide valuable assistance to new project managers by alerting them to thought processes behind user request implementation decisions. Such a system could also be of benefit to Civil Engineering customers because they could understand the thought processes used to evaluate their requests. In lieu of a decision support system, Appendix I is a model of important issues in user requested changes.

Next Chapter of Thesis

Chapter VI (Summary and Recommendations) presents the research results by addressing the research objectives in Chapter I and provides recommendations for further study.

VI. Summary and Recommendations

Chapter Overview

This chapter uses the research data to address the specific objectives of this research, which are the following:

1. To identify factors of effective decision-making actions on user change requests.

2. To arrange these factors in a format that Civil Engineering project managers can use.

3. To recommend ways to implement these factors.

These conclusions should assist the decision-making of design and construction project managers on user requested changes.

This chapter presents a brief summary of the research's findings on the research objectives, identifies limitations of the research, and concludes with recommendations for further research in evaluating user requested changes to facility construction projects.

Specific Objectives

Below is a discussion of the specific conclusions of this research effort. The specific conclusions assume that the goal of this research is not based on the test of any hypothesis. Thus these conclusions may not be representative of the entire population.

1. Regulations provide little guidance to project managers in the evaluation of user requested changes. A project manager mostly relies on their past experience to evaluate requested changes. The most frequently used factors include the following: cost of the request, schedule impact, and funds availability. However, these factors are also stated in AFR 89-1, Design and Construction Management.

2. No individuals or agencies typically dictate to project managers the factors to use in evaluating requests. However, in later project phases, factors from the external environment play a major role in the decision-making process.

3. This research did not uncover an effective decision support system, in use, that project managers use to evaluate user change requests. Most project managers stated that arranging the process in a checklist would not be practical because of the wide variety of circumstances involved with user changes.

4. The model, in Fig. 6.1, shows the important issues in the user requested change process and serves as a starting point for a decision support system. Chapter V describes the analysis to obtain the components in this model. Appendix I is a complete description of the model. This model incorporates the decision-making factors to balance the project quality and facility execution. The two other important issues addressed by this model are the

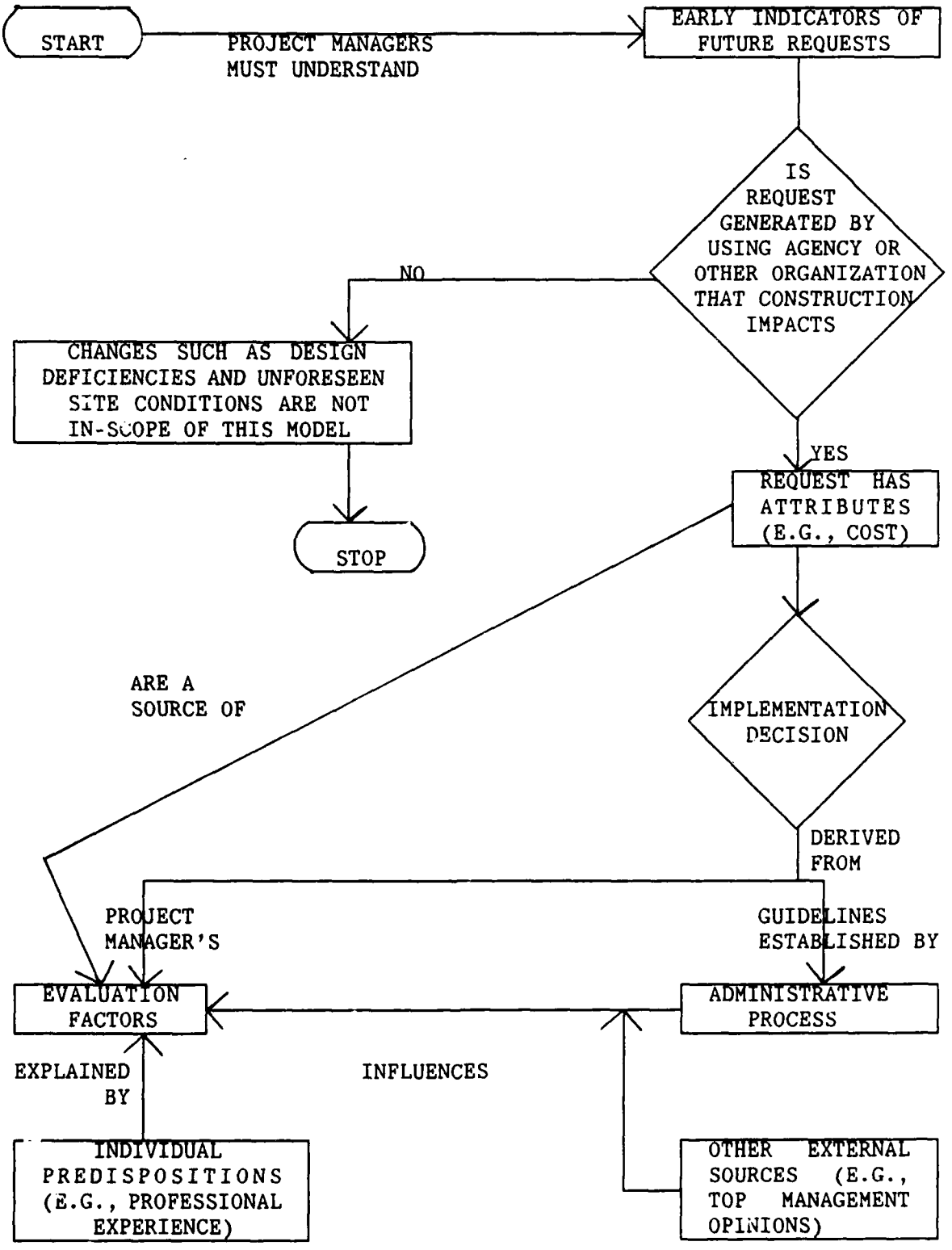

Fig. 6.1. Proposed User Change Request Model

following: (1) the early indicators of future requests, and (2) the administrative process.

5. Appendix I also contains the specific factors with their estimated importance and degrees of difficulty scores when evaluating a user requested change. The research shows these factors can be separated into the following three classifications: (1) attributes of the request, (2) influences upon the individual, and (3) predispositions of the individual. The "attributes" and "influences" factors can be further separated into those associated with either the quality of the facility or the execution of the project. The project manager can then evaluate the requested changes' attributes, situational influences, and individual predispositions to balance building a quality facility (that enhances users' productivity) to project execution (within budget and on-time).

6. All project managers should be able to organize their thought processes in evaluating user change requests. This will enhance the effectiveness of decisions to build a quality facility while at the same time executing the project within available resources. Appendix I is a guide to help project managers understand thought processes on evaluating user requests. This guide provides the opportunity for inexperienced project managers to quickly gain the experience of senior project managers.

Limitations

It is interesting to note that constantly the interviewees stated that "the situation dictates the response." The researcher believes that not all interviewees could recall all details of their past experiences. This does not negate the results of this research, but should be considered by researchers contemplating follow on work.

Recommendations

Specific recommendations for this research and future research are presented below.

1. Consider the distribution of Appendix I (An Understanding of Important Issues on Evaluating User Requested Changes) to design and construction project mangers (especially the lieutenants and new civilians to the Air Force). Also, consider including Appendix I as part of a project manager's guide. This appendix presents the thought processes behind the evaluation of a requested changes. The project managers should consider distributing this information to educate users and customers of Civil Engineering about the change request process.

2. One recognized limitation of this research was that the sample only included Air Force project managers. Future research on requested changes should include study of the similarities or differences between the Air Force,

other agencies in the Department of Defense, or civilian contractors.

Appendix A: Interview Questionnaire

1. Have you worked with users, or any other organization affected by a construction project, who submitted changes to the design criteria or who requested construction contract modifications in MILCON projects beyond the 35% design stage or under construction? Note that design criteria includes user requirements, among other items that the user may desire.

2. Do you consider yourself well qualified in handling these agency's requests for changes in design criteria or contract modifications?

3. The following questions concern the different factors that you may use to evaluate changes in: (1) design criteria (beyond 35% design stage); or (2) contract modifications. Consider the factors you would use to evaluate a request . . .

a. Are you aware of the guidance in the 1 Nov 88 version of AFR 89-1, Design and Construction Management?

(1) If yes, go to question 3b.
(2) If no, go to question 3c.

b. When you evaluate user requested changes in design criteria or user requests for contract modifications, how much guidance would you say the 1 Nov 88 version of AFR 89-1 provides, as compared to other sources (including your personal intuition)? Select one of the responses below.

(1) AFR 89-1 provides a large amount of my guidance.
(2) AFR 89-1 provides a fair amount of my guidance.
(3) AFR 89-1 provides a small amount of my guidance.
(4) AFR 89-1 provides none of my guidance.

c. Were you aware of the guidance in the 20 Jun 78 version of AFR 89-1, Design and Construction Management?

(1) If yes, go to question 3d.
(2) If no, go to question 3f.

d. Did you follow the guidance in the 20 Jun 78 version of AFR 89-1?

(1) If yes, go to question 3e.
(2) If no, go to question 3f.

e. What specific guidance did you follow from the 20 Jun 78 version of AFR 89-1?

f. Do you use any other factors to evaluate user requests to change design criteria or users requesting construction contract modifications?

(1) If yes, go to question 3g.
(2) If no, go to question 3l.

g. Describe the factors you use to evaluate these requests?

h. How are these factors organized (in terms of a checklist, flowchart, etc)?

i. Have your factors from above been officially approved, in other words signed in a letter or included as part of a management plan, etc?

(1) If yes, go to question 3j.
(2) If no, go to question 3l.

j. Who approved your factors?

k. Prior to the approval, who did you discuss or coordinate your factors with?

l. Are there any factors you do not use, but think should be used to evaluate these requests for changes in design criteria or contract modifications?

(1) If yes, go to question 3m.
(2) If no, go to paragraph 4.

m. What are these factors, and why are these factors not being used to evaluate these requests?

4. The following questions relate the user change request to the project status. Consider the following two items: (1) the factors you use to evaluate users, or other organizations, requesting changes in design criteria or contract modifications; and (2) the current completion status of the project . . .

a. Do your factors to evaluate these requests differ when the project is in design, at contracting, or under construction?

(1) If yes, go to question 4b.
(2) If no, go to paragraph 5.

b. What are these differences and how do they vary between the design, contracting, and construction phases?

5. The following questions concern the ranking of each specific evaluation factor you provided above. Consider categorizing your evaluation factors...

a. How important is it to know the answer to each of your specific factors when evaluating a user change request. Select from one of the categories below.

(1) It is important for me to know the answer for that particular factor.
(2) It is moderately important for me to know the answer for that particular factor.
(3) It is not-to-important for me to know the answer for that particular factor.

b. How difficult is it to obtain an answer to each of your specific factors when evaluating a user change request. Select from one of the categories below.

(1) It is easy to obtain an answer to this factor.
(2) It is moderately difficult to obtain an answer to this factor.

(3) It is difficult to obtain an answer to this factor.

6. The following questions are about the approval process of the user requested change in design criteria or requested contract modification. Consider the formal procedures you use to approve or disapprove the user request . . .

a. Does either the user requested change in design criteria or construction modification require formal approval?

(1) If yes, go to question 6b.
(2) If no, go to question 6e.

b. Describe the formal approval process, in terms of: (1) who is involved; (2) what do they do; and (3) how do they do it.

c. Is there a written document that establishes that formal approval process?

(1) If yes, go to question 6d.
(2) If no, go to question 6e.

d. Describe this document(s) and when was it published, in relation to the project?

e. Do the approval policies on user requests vary for different projects?

(1) If yes, go to question 6f.
(2) If no, go to paragraph 7.

f. Describe the difference in the approval policies.

7. The following questions concern the coordination of a requested change in design criteria or contract modification. Consider the organizations that coordinate on the request . . .

a. Is the user requested change in design criteria or requested contract modification coordinated with third organizations (other than the one submitting the change request)?

(1) If yes, to question 7b.
(2) If no, go to question 7e.

b. For each request, is coordination obtained from all agencies involved with the project?

(1) If no, go to question 7c.
(2) If yes, go to question 7d.

c. What agencies are typically coordinated with?

d. How do you obtain this coordination?

e. Have you been in situations were that original request had to be revised?

(1) If yes, go to question 7f.
(2) If no, go to paragraph 8.

f. What circumstances caused this revision?

g. How long after the request was submitted did this revision occur?

8. THE END OF INTERVIEW!!!

3. The following questions concern the different factors that you may use to evaluate changes in: (1) design criteria (beyond 35% design stage); or (2) contract modifications. Consider the factors you would use to evaluate a request . . .

a. Are you aware of the guidance in the 1 Nov 88 version of AFR 89-1, Design and Construction Management?

(1) If yes, go to question 3b.
(2) If no, go to question 3c.

1	N
2	Y
3	N
4	N
5	Y
6	Y
7	Y
8	Y
9	Y
10	Y
11	N
12	Y
13	Y
14	Y
15	N
16	Y
17	Y
18	Y
19	Y
20	Y
21	Y
22	N
23	Y
24	Y
25	Y
26	Y
27	N

b. When you evaluate user requested changes in design criteria or user requests for contract modifications, how much guidance would you say the 1 Nov 88 version of AFR 89-1 provides, as compared to other sources (including your personal intuition)? Select one of the responses below.

(1) AFR 89-1 provides a large amount of my guidance.

(2) AFR 89-1 provides a fair amount of my guidance.
(3) AFR 89-1 provides a small amount of my guidance.
(4) AFR 89-1 provides none of my guidance.

1	---
2	3
3	---
4	---
5	2
6	3
7	4
8	3
9	4
10	3
11	---
12	3
13	1
14	2
15	---
16	2
17	3
18	3
19	3
20	3
21	4
22	---
23	3
24	3
25	3
26	2
27	---

c. Were you aware of the guidance in the 20 Jun 78 version of AFR 89-1, Design and Construction Management?

(1) If yes, go to question 3d.
(2) If no, go to question 3f.

1	Y
2	N
3	N
4	Y
5	Y
6	N
7	Y
8	Y
9	Y
10	N
11	Y
12	Y
13	N
14	Y

15 Y
16 Y
17 Y
18 Y
19 Y
20 Y
21 Y
22 Y
23 Y
24 Y
25 Y
26 Y
27 Y

d. Did you follow the guidance in the 20 Jun 78 version of AFR 89-1?

(1) If yes, go to question 3e.
(2) If no, go to question 3f.

1 Y
2 ---
3 ---
4 Y
5 Y
6 ---
7 N
8 Y
9 N
10 ---
11 N
12 Y
13 ---
14 N
15 Y
16 Y
17 Y
18 Y
19 Y
20 Y
21 Y
22 N
23 Y
24 N
25 Y
26 Y
27 Y

e. What specific guidance did you follow from the 20 Jun 78 version of AFR 89-1?

1 Could not recall any specific criteria.
2 ---

3 ---
4 Could not recall any specific criteria.
5 Method of handling modifications. Funding guidance. Correspondence with Air Staff and other agencies.
6 ---
7 ---
8 Could not recall any specific guidance.
9 ---
10 ---
11 ---
12 Could not recall any specific guidance.
13 ---
14 ---
15 Could not recall any specific guidance.
16 Programming changes.
17 Determination if a change is mission essential.
18 Could not recall any specific criteria.
19 Cost growth and scope change guidance.
20 Change order submittal and approval procedures.
21 Justification of requirement. Determination if a change is mission essential.
22 ---
23 Determination if change meets project book criteria.
24 ---
25 Sections 2-3, 2-14, 4-12, 4-13.
26 Could not recall any specific guidance.
27 Evaluation of changes for timely implementation. Look for ways to support or deny a change request.

f. Do you use any other factors to evaluate user requests to change design criteria or users requesting construction contract modifications?

(1) If yes, go to question 3g.
(2) If no, go to question 31.

1 Y
2 Y
3 N
4 Y
5 Y
6 Y
7 Y
8 Y
9 Y
10 Y
11 Y
12 Y
13 Y
14 Y
15 Y
16 Y
17 Y

18 Y
19 Y
20 Y
21 Y
22 Y
23 Y
24 Y
25 Y
26 Y
27 Y

g. Describe the factors you use to evaluate these requests?

1 (1) Is money available. (2) Common sense. (3) What top level personnel say. (4) Is request within scope. (5) Is request necessary. (6) Is change valid.

2 (1) What does Management Plan have to say. (2) Impact to mission. (3) Benefits to government. (4) Life cycle cost. (5) Is money available.

3 ---

4 (1) Is request a want versus need. (2) Funds availability. (3) Does user know what he wants, look at request from technical viewpoint. (4) Timing (e.g. will change delay bid opening). (5) C.E. maintenance. (6) Facility requirements plans. (7) SATAF opinions. (8) HQ SAC opinions.

5 (1) Is request valid. (2) Is request within project scope (as defined in Air Force criteria, say in Form 1391). (3) Technical aspects and if Air Force guidance exists (e.g. is a/c authorized).

6 (1) Does request affect mission. (2) Complete and usable facility. (3) How does request affect quality of facility. (4) Time schedule. (5) Cost of change (6) Design fund status.

7 (1) Command interest. (2) Functional benefit (based on either P.M. or users call). (3) Cost of request.

8 (1) Percent constructed. (2) Funds availability. (3) Politics. (4) 1391 objectives.

9 (1) Mission impact. (2) PA/CWE ratio. (3) Command funds availability. (4) Schedule impact. (5) Schedule status. (6) Who submitted request. (7) Long term use of facility. (8) Project type (e.g. aboveground versus underground). (9) Funding source.

10 (1) Outside comments from professionals. (2) Cost impacts. (3) Time impacts.

11 (1) Time requirements. (2) Is request valid. (3) Justification of need (by using agency or XB). (4) Does design change have two letter office symbol signature. (5) Impact to schedule and Air Force need date.

12 (1) Does request provide complete and usable facility. (2) Is change "gold plated." (3) Cost of request.

13 (1) Cost of request. (2) Affect on schedule. (3) How bad does user need request versus nice-to-have change. (4) Funds availability.

14 (1) Technical interface requirements. (2) Air Force need date and schedule. (3) Cost of request.

15 Will request make weapons systems work, or is request to support a lesser item.

16 (1) Does request provide a complete and usable facility. (2) Seeks user assistance to offset cost and scope growth.

17 (1) Compare request against ETLs and manuals. (2) Compare request with existing plans to see if what is requested is really required. (3) Is request mission essential.

18 (1) Follow the P.M.'s Design and Construction Manual. (2) Professional experience. (3) Individual talent.

19 (1) Cost of request. (2) Is request within scope. (3) Economic analysis. (4) In borderline cases, consider how important is it to meet project and customer goals while at the same time meeting Air Force execution goals.

20 (1) Personal experience. (2) Knowledge of user and user's mission. (3) Design status. (4) Historical guidance on change requests, say from Air Staff. (5) Cost.

21 (1) How strong is justification. (2) Is request mission essential. (3) What is MAJCOM's opinion towards request. (4) Cost impact. (5) Time impact. (6) Functionality impact.

22 (1) How bad is the request needed. (2) Cost of request. (3) Sensibility. (4) Constructability.

23 (1) What is best for overall Air Force. (2) What is best for the BCE. (3) What is best for the user. (4) Cost of request. (5) How will request impact schedule. (6) Evaluate the request in terms of wants versus the construction status.

24 (1) Funds availability. (2) In construction, will contractor have to rework work already completed. (3) Is request mission essential. (4) Is it legal to incorporate request (e.g. in terms of project scope, etc).

25 (1) Impact on schedule. (2) Cost of request. (3) Project critical need date. (4) Air Force goals. (5) How much does request support mission. (6) How much does change improve morale. (7) Community appearance. (8) Smart idea at the wrong time. (9) Are other options available for request. (10) Availability of funds. (11) What is magnitude of change. (12) When will funds expire.

26 (1) Is there another way to satisfy the requirement. (2) Is request from right level of authority, e.g. base user submitting request without coordination or support of MAJCOM user. (3) Cost-benefit ratio.

27 (1) Will request functionally improve facility. (2) Can request be implemented in a timely manner without delaying project. (3) What is project critical need date. (4) Can request be incorporated in an administrative manner, rather than a change in construction.

h. How are these factors organized (in terms of a checklist, flowchart, etc)?

1 No formal organization.
2 No formal organization.
3 ---
4 No organization, intuitive process.
5 Project books have checklists to follow.
6 Personal intuitive process.
7 No formal guidance.
8 Personal intuitive process.
9 Situation dictates.
10 No formal organization.
11 No formal organization.
12 No formal organization.
13 No organization.
14 No organization.
15 In a operating instruction.
16 Intuition. Changes not recognized as normal business.
17 Own personal organization.
18 No formal organization.
19 No checklist.
20 No formal guidance.
21 No checklist or flowchart used.
22 No formal organization.
23 No formal organization.
24 Organization in Project Managers Guidebook.
25 No formal organization.
26 No formal organization.
27 No flow charts used.

i. Have your factors from above been officially approved, in other words signed in a letter or included as part of a management plan, etc?

(1) If yes, go to question 3j.
(2) If no, go to question 3l.

1 N
2 N
3 ---
4 N
5 Y
6 N
7 N
8 N

9 N
10 N
11 N, except construction aspect - Y
12 N
13 Y
14 Y
15 N
16 Y
17 N
18 N
19 N, except for mission beddown projects.
20 N, except for certain projects.
21 N
22 N
23 N
24 N, except for certain projects.
25 N
26 N, except for certain projects.
27 N

j. Who approved your factors?

1 ---
2 ---
3 ---
4 Factors are based on the philosophy that you can control only two of the following three: cost, quality, or schedule.
5 Air Force
6 ---
7 ---
8 ---
9 ---
10 ---
11 ---
12 ---
13 Engineering and Services.
14 Facility change board.
15 ---
16 P.M. or supervisors.
17 ---
18 ---
19 ---
20 ---
21 ---
22 ---
23 ---
24 ---
25 ---
26 ---
27 ---

k. Prior to the approval, who did you discuss or coordinate your factors with?

1 ---
2 ---
3 ---
4 ---
5 ---
6 ---
7 ---
8 ---
9 P.M. discussed criteria with user, BCE, A/E, agent, resident engineer, SP, comm, or applicable organizations before predesign meeting.
10 ---
11 ---
12 ---
13 The boss.
14 The users.
15 ---
16 ---
17 ---
18 ---
19 ---
20 ---
21 ---
22 ---
23 ---
24 ---
25 Factors are from organizational philosophy, and unwritten.
26 ---
27 ---

l. Are there any factors you do not use, but think should be used to evaluate these requests for changes in design criteria or contract modifications?

(1) If yes, go to question 3m.
(2) If no, go to question 4.

1 Y
2 N
3 N
4 N
5 N
6 N
7 Y
8 Y
9 N
10 N
11 N
12 N

13 N
14 N
15 N
16 N
17 Y
18 N
19 N
20 N
21 N
22 N
23 N
24 Y
25 N
26 N
27 Y

m. What are these factors, and why are these factors not being used to evaluate these requests?

1 Exclude politics (hard to do).
2 ---
3 ---
4 ---
5 ---
6 ---
7 Guidance from 89-1. P.M. can not defend position by following regulation because user does not want to hear C. E. say "we can not do it because the reg says so."
8 Consider changing the 1391 to increase project scope (hard to do, since Congressionally approved).
9 ---
10 ---
11 ---
12 ---
13 ---
14 ---
15 ---
16 ---
17 MAJCOM should verify if request is mission essential.
18 ---
19 ---
20 Technical and industry manuals that deals with aspects of request. Commanders may not be aware of details.
21 ---
22 ---
23 ---
24 Timing when requests are identified. Need to sort out personal preferences versus essential requests.
25 ---
26 ---
27 Personal preferences should be eliminated.

4. The following questions relate the user change request to the project status. Consider the following two items: (1) the factors you use to evaluate users, or other organizations, requesting changes in design criteria or contract modifications; and (2) the current completion status of the project...

a. Do your factors to evaluate these requests differ when the project is in design, at contracting, or under construction?

(1) If yes, go to question 4b.
(2) If no, go to question 5.

1	Y
2	Y
3	N
4	Y
5	Y
6	Y
7	Y
8	Y
9	Y
10	Y
11	Y
12	N
13	N
14	N
15	Y
16	Y
17	Y
18	Y
19	N
20	Y
21	Y
22	Y
23	Y
24	Y
25	Y
26	Y
27	Y

b. What are these differences and how do they vary between the design, contracting, and construction phases?

1	Less expensive to incorporate change in design, unless change delays execution (e.g. bid opening).
2	More likely to approve changes (thus less scrutinized) in design versus in contracting or under construction. While at contracting, consider time of fiscal year, balance that out with user need of project.
3	---

4 In design or contracting, look at need date then decide how close to look at change request. In construction, tends to be more lenient, but also considers if work can be done by a follow-on contract.

5 Design, compare change to scope and costs. In contracting and construction, compare change to project scope.

6 Factors are same, weights change. In construction, look at cost of modification and when can it be incorporated into project (maybe wait until end of project). In contracting, changes are closely scrutinized because of strong desire to award project.

7 More strict as proceeding from design through construction.

8 Less expensive to make changes in design, rather than construction.

9 Situation dictates. Less expensive to stop a construction contractor rather than an A/E. In design and contracting, consider how flexible the milestones are. In construction, consider the cost of the change versus money available.

10 Changes during design and contracting cost less than changes in construction.

11 In design, P.M. just manages a schedule. In construction, P.M. must manage a contract.

12 ---

13 ---

14 ---

15 In design, more liberal with changes, but concerned about costs, also trys to eliminate ridiculous changes. In construction, changes are more stringently looked at.

16 In design, look at criteria, scope, and cost. In contracting, look at criteria, and if change will provide a complete and usable facility. In construction, look at scope and cost growth.

17 In construction, need to ask user if willing to slip beneficial occupancy date. In contracting, P.M. is willing to incorporate if there is enough time to amend the bid package without slipping the bid opening date.

18 Should be no user requests after 35 percent design. Try to talk user out of request. If needed, design are better than construction changes because changing a design involves only changing paper.

19 ---

20 In design there is more flexibility to accommodate change requests. At contracting, do not want to impact the bid opening date.

21 More lenient to incorporate request in early stages of design.

22 Increasing hesentency to incorporate change when project is design versus contracting versus construction.

23 In construction, less likely to implement change. Also, in construction consider the relations between the Air Force and the contractor.
24 In design, it is easier to incorporate a change versus if the project is in contracting or construction.
25 Timing of the request impacts costs. The earlier the change is identified, the less it will cost to incorporate the request.
26 In design, the goal is to meet the schedule. In construction, the goal is to meet the costs (so different approaches are sought to incorporate the request, rather than using construction).
27 To incorporate a change costs more in construction, rather than design. So the request is looked at more closely in construction rather than design.

5. The following questions concern the ranking of each specific evaluation factor you provided above. Consider categorizing your evaluation factors...

a. How important is it to know the answer to each of your specific factors when evaluating a user change request. Select from one of the categories below.

(1) It is important for me to know the answer for that particular factor.
(2) It is moderately important for me to know the answer for that particular factor.
(3) It is not-to-important for me to know the answer for that particular factor.

1 (1), (2), (3), (4), (5), (6) - 1.
2 (1), (2), (3) - 1. (4) - 2. (5) - 1.
3 ---
4 (1) - 1. (2) - 2. (3) - 1. (4), (5) - 2. (6) - 3. (7), (8) - 2.
5 (1) - 2. (2) - 1. (3) - 2.
6 (1), (2), (3) - 1. (4) - 2. (5) - 1. (6) - 2.
7 (1), (2), (3) - 1.
8 (1), (2) - 1. (3) - 2. (4) - 1.
9 (1), (2), (3), (4), (5), (6), (7), (8), (9) - 1.
10 (1), (2), (3) - 1.
11 (1), (2), (3), (4), (5) - 1.
12 (1), (2), (3) - 1.
13 (1), (2), (3), (4) - 1.
14 (1), (2), (3) - 1.
15 ---
16 (1), (2) - 1.
17 (1), (2), (3) - 1.
18 (1), (2), (3) - 1.
19 (1), (2) - 1. (3) - 2. (4) - 1.
20 (1), (2), (3) - 1. (4), (5) - 2.
21 (1), (2) - 2. (3), (4) - 1. (5), (6) - 2.

22 (1), (2) - 1. (3) - 2. (4) - 1.
23 (1), (2) - 2. (3), (4), (5), (6) - 1.
24 (1), (2), (3), (4) - 1.
25 (1), (2), (3) - 1. (4) - 3. (5) - 1. (6) - 2.
(7) - 1. (8) - 2. (9), (10) - 1. (11), (12) - varies based on status.
26 (1), (2) - 1. (3) - 3.
27 (1) - 1. (2) - 2. (3) - 3. (4) - 2.

b. How difficult is it to obtain an answer to each of your specific factors when evaluating a user change request. Select from one of the categories below.

(1) It is easy to obtain an answer to this factor.
(2) It is moderately difficult to obtain an answer to this factor.
(3) It is difficult to obtain an answer to this factor.

1 (1), (2), (3) - 1. (4) - 3. (5) - 1. (6) - 3.
2 (1) - 1. (2), (3), (4) - 2. (5) - 1.
3 ---
4 (1) - 3. (2) - 1. (3), (4) - 2. (5), (6) - 1. (7), (8) - 2.
5 (1), (2), (3) - 1.
6 (1) - 2. (2), (3) - 1. (4), (5) - 2. (6) - 1.
7 (1), (2) - 3. (3) - 1.
8 (1), (2) - 2. (3) - 3. (4) - 2.
9 (1), (2), (3), (4), (5), (6), (7), (8), (9) - 1.
10 (1) - 2. (2), (3) - 3.
11 (1) - 2. (2) - 3. (3) - 2. (4) - 3. (5) - 2.
12 (1), (2) - 1. (3) - 2.
13 (1), (2), (3) - 2. (4) - 1.
14 (1), (2), (3) - 1.
15 ---
16 (1), (2) - 2.
17 (1) - 1. (2) - 2. (3) - 1.
18 (1), (2) - 1. (3) - 3.
19 (1) - 2. (2) - 1. (3) - 3. (4) - 1.
20 (1) - 1. (2) - 2. (3) - 1. (4), (5) - 2.
21 (1), (2) - 2. (3) - 1. (4) - 2. (5), (6) - 3.
22 (1) - varies. (2) - 1. (3) - varies. (4) - 1.
23 (1), (2) - 1. (3) - 2. (4), (5) - 1. (6) - 2.
24 (1) - 1. (2) - 3. (3), (4) - 1.
25 (1) - 2. (2), (3), (4) - 1. (5), (6), (7), (8) - 3. (9) - 2. (10) - 1. (11) - 2. (12) - 1.
26 (1), (2), (3) - 1.
27 (1), (2) - 2. (3) - 1. (4) - 3.

6. The following questions are about the approval process of the user requested change in design criteria or requested contract modification. Consider the formal

procedures you use to approve or disapprove the user request . . .

a. Does either the user requested change in design criteria or construction modification require formal approval?

(1) If yes, go to question 6b.
(2) If no, go to question 6e.

1 N
2 Y
3 ---
4 Y
5 Y (only if violates AFM 88-15, ETLs or CTLs)
6 Y
7 Y
8 Y
9 Y
10 Y
11 Y (construction only)
12 Y
13 Y
14 Y
15 Y
16 Y
17 Y
18 Depends on request itself, and powers of persuasion.
19 Y
20 Y
21 N
22 Case-by-case basis.
23 Y
24 Y
25 Y
26 Y
27 Y

b. Describe the formal approval process, in terms of (1) who is involved; (2) what do they do; and (3) how do they do it.

1 ---
2 Using agency sends request to BCE. BCE does quick cost estimate, and initial screening. Then request sent to MAJCOM, for coordination. Then decision made. If approved, sent to Corps. If disapproved, sent back to base.
3 ---
4 User, agent, AFRCE, MAJCOM, SATAF, BCE, XB are organizations involved. Design is less formal process,

as compared to construction. Weekly construction management meetings held.

5 Go to Air Staff asking for approvals or waivers.

6 MAJCOM DE approval required on changes that impact firm dates (i.e. provided to Corps) on major beddowns.

7 User asks for change. Cost estimate obtained from Corps. If money available and reasonable request, then change incorporated. If not, then change request returned.

8 From user to base DEE, who submits to MAJCOM, who sends to Corps. Informal cost estimate and impacts obtained, this information used to make decision.

9 From user, to BCE (who validated request). Then request sent to AFRCE (on site representative). If less than $25k, then given to agent. If more than $25k, MAJCOM approval required.

10 Base handles all changes whose combined dollar value is less than the management reserve. Otherwise, MAJCOM approval required.

11 Requests are discussed at construction board, who meets on a regular basis.

12 User identifies why request is required. P.M. obtains cost estimate. P.M. obtains coordination of his boss.

13 Determine cost of change request. Then check if request is nice-to-have versus required. If required, then pass request on to engineers.

14 Decisions made at FAB board. Board consists of user, design and construction agents, and applicable organizations.

15 AFRCE resident engineer responsible for approval/ disapproval of requests up to $50k. Main office AFRCE approval required for changes greater than $50k.

16 Facilities change board (consisting of user, AFRCE, and other agencies involved) reviews change request against project book criteria.

17 Request goes from base to MAJCOM to AFRCE. MAJCOM approves. AFRCE implements, and determines if the request is in the best interest of the project.

18 Decisions made at the design conference.

19 Request goes from base to MAJCOM (determines validity of change) to AFRCE.

20 Request goes from MAJCOM to AFRCE to design or construction agent.

21 User submits change to BCE and command users.

22 P.M. works with MAJCOM to incorporate request.

23 P.M. works with point of contact on base. To save time, P.M. will implement request.

24 Request goes from user to BCE to MAJCOM to AFRCE to design or construction agent.

25 Design is informal process, as requests are brought up and evaluated at design conferences. More formal process in construction, as request is sent from MAJCOM to AFRCE to design or construction agent.

26 In design, request goes from user to MAJCOM to AFRCE to Corps. In construction, when P.M. receives a request he will implement it (as long as management reserve exists).
27 Request goes from user to MAJCOM to AFRCE to Corps.

c. Is there a written document that establishes that formal approval process?

(1) If yes, go to question 6d.
(2) If no, go to question 6e.

1 ---
2 Y
3 ---
4 Y
5 N
6 N
7 N
8 Y
9 Y
10 Y
11 N - design. Y - construction.
12 N
13 Y
14 Y
15 Y
16 Y
17 Y
18 Y
19 Y
20 Y
21 ---
22 Y
23 N
24 Y
25 Y
26 Y
27 Y

d. Describe this document(s) and when was it published, in relation to the project?

1 ---
2 Management plans. MAJCOM delegation of some changes to base letter.
3 ---
4 B-1, B-2 Management Plans. Published after design and before construction.
5 ---
6 ---
7 ---
8 Larger projects have formal management plans.

9 B-1 Management Plan.
10 Can not recall document.
11 Management plan.
12 ---
13 Management plan.
14 Management plan.
15 Operating Instructions.
16 Facility Acquisition Strategy Plan. Normally published prior to design.
17 89-1. Mission beddown had a specific management plan.
18 Project Managers' Handbook.
19 89-1.
20 89-1 and Project Managers' Handbook.
21 ---
22 89-1.
23 ---
24 89-1.
25 89-1.
26 Project Manager's Handbook.
27 89-1.

e. Do the approval policies on user requests vary for different projects?

(1) If yes, go to question 6f.
(2) If no, go to question 7.

1 N
2 Y
3 ---
4 N
5 N
6 Y
7 Y
8 Y
9 Y
10 N
11 N
12 Y
13 N
14 N
15 N
16 N
17 Y
18 N
19 Y
20 N
21 Y
22 Y
23 Y
24 N
25 N

26 Y
27 Y

f. Describe the difference in the approval policies.

1 ---
2 If cost of change is below a certain limit, can be delegated to base.
3 ---
4 ---
5 ---
6 Depends on project type and its visibility.
7 Nothing is standard. Unless change impacts scope or cost to the point where Air Staff approval is required.
8 If cost of change is below a certain limit, can be delegated to base.
9 Varies based on BOS or beddown project.
10 ---
11 ---
12 Varies based on project.
13 ---
14 ---
15 ---
16 ---
17 Medical projects have their additional organizations that must coordinate on request.
18 ---
19 Varies only when management plan exists.
20 ---
21 Larger projects have a more formal approval process.
22 Interpretation of the regulations and policies are different for each command and user.
23 Varies by command.
24 ---
25 ---
26 Depends on who is driving the request.
27 Medical projects and requests over $100k require additional organizations to coordinate on the request.

7. The following questions concern the coordination of a requested change in design criteria or contract modification. Consider the organizations that coordinate on the request . . .

a. Is the user requested change in design criteria or requested contract modification coordinated with third organizations (other than the one submitting the change request)?

(1) If yes, go to question 7b.
(2) If no, go to question 7e.

1 Y
2 Y
3 ---
4 Y
5 Y
6 Y
7 Y
8 Y
9 Y
10 Y
11 Y
12 Y
13 Y
14 Y
15 Y
16 Y
17 Y
18 Y, normally coordination accomplished before P.M. receives request.
19 Y
20 Y
21 Y
22 Y, in some instances.
23 Y, in some instances.
24 Y
25 Y
26 Y
27 Y

b. For each request, is coordination obtained from all agencies involved with the project?

(1) If no, go to question 7c.
(2) If yes, go to question 7d.

1 N
2 Y
3 ---
4 Y
5 Y
6 Y
7 Y
8 N
9 Y (applicable agencies)
10 Y
11 Y
12 N
13 Y
14 Y
15 Y
16 Y
17 Y
18 ---

19 Y (coordinated with agencies that have a need-to-know. Other agencies receive info copies).
20 N
21 Y (all agencies at least notified).
22 Y
23 N
24 N
25 Y (qualified by type of change).
26 N (depends on agencies affected).
27 Y

c. What agencies are typically coordinated with?

1 Always coordinate with design and construction agent. Other agencies are based on P.M.'s determination of a need to know.
2 Varies based on type of project. Other agencies are based on P.M.'s determination of a need to know.
3 ---
4 ---
5 ---
6 ---
7 SP, communications.
8 Communications, SP, user, DEM, DEV.
9 SP, communications, BCE (DEM, DEE), user, user's boss, building occupant counterpart, applicable organization in MAJCOM and other MAJCOMs.
10 ---
11 ---
12 BCE organization.
13 MAJCOMs, SPOs, user, Corps.
14 ---
15 All agencies are invited to comment. If P.M. does not hear from agency, then assume agency concurs.
16 ---
17 ---
18 ---
19 ---
20 Any applicable organization.
21 Host and user command.
22 ---
23 Agencies that have a need-to-know.
24 Communications.
25 Fire department, safety, multiple users.
26 Agencies that have a need-to-know.
27 ---

d. How do you obtain this coordination?

1 By phone. Sensitive issues, send letter out to applicable agencies.
2 Write up response, then obtain coordination from various agencies.

3 ---
4 At weekly meetings (talk about request, if more info is needed then XB drives requests).
5 Phone (to tell organization of a change), then follow up with a letter.
6 Through group meetings. Phone coordination.
7 Use buc slip for DE offices. Formal coordination from offices outside DE.
8 Formal letter to MAJCOM counterpart.
9 Varies - verbally to writing.
10 Phone calls and memos.
11 Design - formal review conference. Construction - working groups.
12 BCE assists with coordination.
13 By letter. If urgent, then verbally.
14 All organizations sign off on the form containing the facility engineering change proposal.
15 Use the "AFRCE form."
16 At the facilities engineering change board.
17 MAJCOM does coordination.
18 ---
19 Phone calls.
20 Phone calls.
21 Use phone calls and memos to notify agencies. In writing obtain coordination from agencies.
22 In writing.
23 Phone calls. Follow up with a message or letter.
24 In writing.
25 Phone calls.
26 Letters and/or messages.
27 Phone calls.

e. Have you been in situations were that original request had to be revised?
(1) If yes, go to question 7f.
(2) If no, go to paragraph 8.

1 Y
2 Y
3 ---
4 Y
5 Y
6 Y
7 Y
8 Y
9 Y
10 Y
11 Y
12 Y
13 Y
14 Y
15 Y
16 Y

17 Y
18 N
19 Y
20 Y
21 Y
22 Y
23 Y
24 Y
25 Y
26 Y
27 Y

f. What circumstances caused this revision?

1 Funds availability.
2 Poor planning (someone did not think the process through).
3 ---
4 New or bad information. Constructability problems. Change request was out of scope. Great idea at wrong time.
5 Change request was out of scope. Engineers misunderstood request.
6 Change in equipment. Change in chain-of-command. Change in mission.
7 Change in personnel. Personnel changing their minds. Change in mission.
8 New info brought out during coordination.
9 Late breaking criteria.
10 Cost of request, compromise reached during technical evaluation.
11 Design accomplished at same time as R and D work.
12 Change involved historical facilities.
13 Not enough money for change. No urgent need to do change.
14 Inadequate data.
15 Lack of knowledge of person submitting change.
16 Maturity of construction criteria.
17 BCE or MAJCOM or AFRCE may not concur with request. BCE identifies technical reason.
18 ---
19 Further studying of request reveals that change is not needed.
20 MAJCOM desires.
21 Many reasons. Changed site conditions. Cost. Legal aspect of request. Time impact. Other persons stating impacts of change on their agency.
22 BCE maintainability. Availability of spare parts. Accessibility.
23 Equipment arrival dates.
24 Users were not able to visualize the blueprints.

25 Incomplete coordination. In addition, agencies did not completely understand change or have all the information about the change.
26 Cost of request.
27 Real requirement brought out in coordination process (e.g. requirement was for security storage not security vault).

g. How long after the request was submitted did this revision occur?

1 Hours.
2 Days.
3 ---
4 Months.
5 Two to three weeks.
6 Varies from a week until after facility was complete.
7 Week to two months.
8 Two weeks
9 Situational.
10 Few weeks.
11 Months.
12 Three weeks.
13 A week.
14 Two to three weeks for design changes. Four to six weeks for construction changes.
15 A week.
16 Immediately to three months.
17 Six weeks.
18 ---
19 Varies from weeks to months.
20 A week.
21 A week.
22 Varies, one day was best time.
23 Four to five months.
24 Could not recall.
25 Hours to three months.
26 Varies two to five months.
27 Six months.

8. THE END OF INTERVIEW!!!

Appendix C: Distribution of Evaluation Factors

Table C.1

Evaluation of Additional Factors Used to Evaluate User Change Requests

Response	Count	Percent	Important	Moderately Important	Not-too-Important	Easy	Moderately Difficult	Difficult
Cost of Request	12	46.15	11	1	0	5	6	1
Schedule Impact	10	38.46	6	4	0	2	6	2
Funds Availability	8	30.77	7	1	0	7	1	0
Is Request a Want or Need	7	26.92	6	1	0	1	4	1
Impact to Mission or Mission Essential	7	26.92	6	1	0	3	3	1
In Scope (Legal)	5	19.23	5	0	0	3	1	1
Technical Evaluation (Against ETLs and Manuals)	4	15.38	3	1	0	3	1	0
Complete and Usuable Facility	3	11.54	3	0	0	2	1	0
MAJCOM Opinions (MAJCOM Support)	3	11.54	2	1	0	2	1	0
Are Other Options Available	3	11.54	2	1	0	1	1	1
Is Change Valid	3	11.54	2	1	0	1	0	2
Benefit to Government or Air Force	3	11.54	1	1	1	2	1	0
Life Cycle Cost (Economic Analysis)	3	11.54	0	2	1	1	1	1
Functional Benefit to User	3	11.54	2	1	0	0	1	2
Design or Construction Status	2	7.69	2	0	0	2	0	0
Who Submitted Request	2	7.69	2	0	0	1	0	1
Funding Source and Expiration Date	2	7.69	1	0	0	2	0	0
Critical Need Date	2	7.69	1	0	1	2	0	0
How Sensible Is Request (Magnitude)	2	7.69	0	1	0	0	1	0
Time Requirements (How Soon Does User Need Change)	2	7.69	2	0	0	1	1	0
Professional Experience	2	7.69	2	0	0	2	0	0
Top Level Management Opinions	2	7.69	1	1	0	1	0	1
Quality of Facility	2	7.69	2	0	0	1	1	0
Compare Against Facility Requirements Plans	2	7.69	1	0	1	1	1	0
Maintenance of Real Property	1	3.85	0	1	0	1	0	0
Constructability	1	3.85	1	0	0	1	0	0
Historical Official Guidance on Change Requests	1	3.85	0	1	0	0	1	0
Knowledge of User and User Mission	1	3.85	1	0	0	0	1	0
Common Sense	1	3.85	1	0	0	1	0	0
Guidance in Management Plan	1	3.85	1	0	0	1	0	0
Community Appearance	1	3.85	1	0	0	0	0	1

Table C.1 (Continued)

Response	Count	Percent	Important	Moderately Important	Not-too-Important	Easy	Moderately Difficult	Difficult
Improve Morale	1	3.85	0	1	0	0	0	1
Does Request Require Rework of Complete Work	1	3.85	1	0	0	0	0	1
Best for BCE	1	3.85	0	1	0	1	0	0
Smart Idea at Wrong Time	1	3.85	0	1	0	0	0	1
Balance Execution to Customer Satisfaction	1	3.85	1	0	0	1	0	0
Design Fund Status	1	3.85	0	1	0	1	0	0
Long Term Use of Facility	1	3.85	1	0	0	1	0	0
Project Type	1	3.85	1	0	0	1	0	0
Percent Constructed	1	3.85	1	0	0	0	1	0
PA/CWE Ratio	1	3.85	1	0	0	1	0	0
Commad Special Interest in Project	1	3.85	1	0	0	0	0	1
Seek User Assistance to Offset Cost, Scope Growth	1	3.85	1	0	0	0	1	0
Guidance in P.M. Design and Construction Manual	1	3.85	1	0	0	1	0	0
Individual Talent	1	3.85	1	0	0	0	0	1
Outside Professional Opinions	1	3.85	1	0	0	0	1	0
On-Site Personnel (SATAF) Opinions	1	3.85	0	1	0	0	1	0
Is Request Gold-Plated	1	3.85	1	0	0	1	0	0
	118		87	25	4	58	38	20

Appendix D: Reasons to Change the Request

Table D.1

Frequency Count of the Various Circumstances that Caused a Revision to the Original Requested Change

Response	Count	Percent
Funds availability	5	20
Poor planning	1	4
New information no one could have control over	2	8
Bad information	3	12
Constructability	1	4
Out of scope idea	3	12
Great idea at wrong time	1	4
Engineering misunderstood request	2	8
Equipment change	2	8
Personnel change	2	8
Mission change	2	8
Personnel changing their minds	2	8
New information brought out during coordination	2	8
Design accomplished at same time as RD work	2	8
Historical facilities involved	1	4
Request was not so urgent	2	8
Office not concurring for technical reasons	1	4
Time impact of request	1	4
Changed site conditions	1	4
Maintainability	1	4
Spare parts	1	4
Users could not visualize blueprints	1	4
Incomplete coordination	1	4
Real requirement brought in coordination process	1	4

Appendix E: Differences to Evaluate Change Requests

Table E.1

Frequency Count of the Various Circumstances that Caused Revisions to the Original Requested Change

Response	Count	Percent
Less expensive to incorporate change in design, rather than in contracting and construction. Look more closely at changes in contracting or construction. More flexible to accommodate request in design.	16	64
At contracting, look at time in fiscal year, balance with Air Force milestones and user need of project.	5	20
In construction, consider if work can be done by follow-on contract.	1	4
More lenient with requests in construction.	1	4
In design, compare change to scope and costs. In contracting or construction, compare to project scope.	1	4
Factors are same, weights change.	1	4
In construction, more likely to make change at end of project and if management reserve is available.	2	8
In design and contracting, P.M. considers milestone impacts. In construction, P.M. considers money impacts.	3	12
In construction, is user willing to slip beneficial occupancy date.	1	4
In design, look at criteria, scope, and cost. In contracting, look at criteria, and if change will provide a complete and usable facility. In construction, look at scope and cost growth.	1	4
Should be no requests after 35 percent design. Talk users out of it.	1	4
In construction, consider the relations between the contractor and Air Force.	1	4

Appendix F: Various Types of Approval Processes

Table F.1

Frequency Count of Various Types of Approval Processes on Requested User Changes

Response	Count	Percent
Using agency requests the base for change. Coordination is accomplished at base level. Request sent to MAJCOM. Coordination is accomplished at MAJCOM. Request sent to AFCRE. Coordination is accomplished with AFCRE.	13	54.2
Using agency requests the base (either AFCRE representative or base Civil Engineering) for change. If change costs below a certain limit, base can approve change.	3	12.3
Meetings held at regular intervals, all players in the construction process (from Civil Engineering to user) attend meeting and changes are discussed and finalized at the meeting.	4	16.6
Only go to Air Staff to ask for approvals or waivers.	1	4.2
Base can handle all changes whose cumulative dollar value is below a certain management reserve.	1	4.2
Requests brought up at design reviews and decisions made at the review.	2	8.3
Project manager works with user to incorporate as many of reasonable requests as possible.	2	8.3

Appendix G: Grouping of Factors

Table G.1

Grouping of Factors to Evaluate Requested Changes

Classification Type	Category Type	Response		Count	Count and Importance Score	Weighted Difficulty Score
Attribute	Execution	Cost of Request		12	35	1.67
Attribute	Execution	Schedule Impact		10	26	2.00
Attribute	Execution	In Scope (Legal)		5	15	1.60
Attribute	Execution	Complete and Usuable Facility		3	9	1.33
Attribute	Execution	Is Change Valid		3	8	2.33
Attribute	Execution	Is Request Gold Plated		1	3	1.00
Attribute	Execution	Constructability		1	3	1.00
Attribute	Execution	Does Request Require Rework of Completed Work		1	3	3.00
			Subtotal =	36	102	AVG = 1.74
Attribute	Others	Who Submitted Request		2	6	2.00
			Subtotal =	2	6	AVG = 2.00
Attribute	Quality	Is Request a Want or Need		7	20	1.71
Attribute	Quality	Impact to Mission or Mission Essential		7	20	1.71
Attribute	Quality	Functional Benefit to User		3	8	2.67
Attribute	Quality	Time Requirements (How Soon Does User Need Change)		2	6	1.50
Attribute	Quality	Benefit to Government or Air Force		3	6	1.33
Attribute	Quality	Life Cycle Cost (Economic Analysis)		3	5	2.00
Attribute	Quality	Critical Need Date		2	4	1.00
Attribute	Quality	Community Appearance		1	3	3.00
Attribute	Quality	Improve Morale		1	2	3.00
Attribute	Quality	How Sensible Is Request (Magnitude)		2	2	1.00
Attribute	Quality	Maintenance of Real Property		1	2	1.00
			Subtotal =	32	78	AVG = 1.81

Table G.1 (Continued)

Classification Type	Category Type	Response		Count	Count and Importance Score	Weighted Difficulty Score
Influence	Execution	Funds Avalability		8	23	1.13
Influence	Execution	Design or Constructiun Status		2	6	1.00
Influence	Execution	Balance Execution to Customer Satisfaction		1	3	1.00
Influence	Execution	Percent Constructed		1	3	2.00
Influence	Execution	Guidance in Management Plan		1	3	1.00
Influence	Execution	Guidance in P.M. Design and Construction Manual		1	3	1.00
Influence	Execution	Funding Source and Expiration Date		2	3	1.00
Influence	Exectuion	PA/CWE Ratio		1	3	1.00
Influence	Execution	Design Fund Status		1	2	1.00
Influence	Execution	Historical Official Guidance on Change Requests		1	2	2.00
			Subtotal =	19	51	AVG = 1.21
Influence	Others	MAJCOM Opinions (MAJCOM Support)		3	8	1.33
Influence	Others	Top Level Management Opinions		2	5	2.00
Influence	Others	Project Types		1	3	1.00
Influence	Others	Outside Professional Opinions		1	3	2.00
Influence	Others	Best for BCE		1	2	1.00
Influence	Others	On-Site Personnel (SATAF) Opinions		1	2	2.00
			Subtotal =	9	23	AVG = 1.56
Influence	Quality	Technical Evaluation (Against ETLS and Manuals)		4	11	1.25
Influence	Quality	Quality of Facility		2	6	1.50
Influence	Quality	Compare Against Facility Requirements Plans		2	4	1.50
Influence	Quality	Command Special Interest in Project		1	3	3.00
Influence	Quality	Long-Term Use of Facility		1	3	1.00
			Subtotal =	10	27	AVG = 1.65
Predisposition	Others	Are Other Options Available		3	8	2.00
Predisposition	Others	Professional Experience		2	6	1.00
Predisposition	Others	Knowledge of User and User Mission		1	3	2.00
Predisposition	Others	Common Sense		1	3	1.00
Predisposition	Others	Seek User Assistance to Offset Cost, Scope Growth		1	3	2.00
Predisposition	Others	Individual Talent		1	3	3.00
Predisposition	Others	Smart Idea at Wrong Time		1	2	3.00
			Subtotal =	10	28	AVG = 2.00

Appendix H: Statistix Simple Correlation Computer Runs

SIMPLE CORRELATIONS

	COUNT	IMPORT	DIFF
COUNT	1.0000		
IMPORT	0.9889	1.0000	
DIFF	-0.0203	-0.0130	1.0000

CASES INCLUDED 48 MISSING CASES 0

Appendix I: An Understanding of Important Issues on Evaluation of User Requested Changes

1. So you thought your project would present no problems to award in the current fiscal year, or within the authorized budget limit. Remember that Civil Engineering is a service organization and also is in a change oriented business, so put two and two together.

2. What do you do when the customer requests a change to the design and/or construction? You can first try looking at AFR 89-1, Design and Construction Management, but most of your colleagues will evaluate the requested change based on their past experience. If you feel like you do not have a great deal of past experience, then consider reading this to acquire the experience of one AFIT research effort. Important note: This document is not intended to supercede any regulation or management plan.

3. The project manager should understand three major aspects in evaluating user change requests. They are the following: (1) the early indicators of future requests, (2) the administrative process, and (3) the evaluation factors. Each of these aspects is explained below.

4. Three classes of circumstances dictate if the users are likely to request changes in the project later phases. These circumstances are the following: (1) working with information that no one has control over, (2) misunderstandings, and (3) poor staff work.

a. Table I.1 shows specific circumstances for each category. If misunderstandings or poor staff work exists in the predesign or conceptual design process, then the project may expect more than a "fair share" of user requests. A fair share of requests are the result of information that no one has control over (e.g., mission change).

b. It is important for the project manager to recognize any or all of the above circumstances during the predesign phases.

5. An effective project manager does not become just reactionary to the user change request process. Project managers need to plan their actions upon receiving a change request.

a. The first item to consider is just what type of project are you managing. Obviously it is not an easy one;

otherwise, you would not be involved! But some projects are more difficult to execute than others.

b. The next item to consider is "do you have a formal management plan that addresses how to process the requests, and are all players involved with the construction aware of that plan."

(1) Do all the users and players understand you will use an orderly process to evaluate the changes? Do they also understand that process?

(2) Before starting design, do you have a list of all organizations involved (not just the user or the organizations that the construction area impacts) and their designated points of contact?

c. Does the management plan address coordination of the requested changes? Most project managers work in an environment where the requested change requires formal approval (someone or organization other than the project manager).

(1) Do you have regularly scheduled meetings where one agenda item is to discuss requested changes or possible future requested changes?

(2) At these meetings, you should let only one person provide that organization's comments on a requested change.

(3) Obtain everything in writing. If time requires acting expeditiously, then follow up with written correspondence.

d. A typical management plans does not include specific details such as the factors listed in Table I.2. These factors represent the creativity of others, besides regulations and management plans, to solve implementation problems. Also, most project managers feel their factors have not been officially approved.

6. Ask an old pro on evaluating requested changes, and he'll probably say "the situation dictates." He probably does not realize that there are three main classifications that explain why people act as they do in evaluating user requested changes.

a. The first is predispositions of the individual. Predispositions are the project managers' motives prior to the action. These motives could be gained from common sense, professional experience, or other sources.

b. The second is influences on the individual. An example is a third organization who also must coordinate on the request, thus becoming an "influence" on the individual evaluating the change.

c. The third is attributes of the request. These include cost, schedule impact, etc.

7. Table I.2 contains a listing of the factors, obtained from experts, to evaluate requested changes. You may not

need to address all these factors on individual changes, but reviewing the list provides the experience of others.

a. The factors in Table I.2 are categorized in two ways.

(1) First, Table I.2 classifies the factors into either one of the three classifications (that describe why people act as they do). These classifications are the following: (1) attributes, (2) influences, and (3) predispositions.

(2) Second, the factors in the "attribute" and "influence" classifications are divided into those that deal with project execution (e.g. on time and within available resources) and facility quality (enhancing user productivity). A third category is "others" (which does not fit into the "execution" and "quality" categories). Individual or agency opinions typically fall into this third category.

b. Table I.2 also includes the following two scores: (1) a "Count and Importance" score, where a higher score indicates more frequent use and more importance associated with that factor; and (2) "Weighted Difficulty" score, where a score of one means the factor would be easy to address and a score of three means the factor would be difficult to address.

c. This list should be complete. In compiling Table I.2, most project managers stated that there are no other factors to evaluate requested changes.

8. As the project passes through the various stages of the programming, design, and construction process consider about how your evaluation factors will change during these different stages.

a. Most experienced project managers would state that the project proceeding through design and construction increases the difficulty to incorporate a requested change. A typical project manager's predispositions toward a request would not change in different project phases. The external operating environment makes it increasing difficult to incorporate the change.

b. Consider incorporating some flexibility in the conceptual design phase, if you know during later project phases you will receive requested changes.

9. If you need any further information, considering asking your favorite MAJCOM or AFRCE for assistance. After all, their responses were used in the preparation of this document.

Table I.1

Classes of Circumstances that Represent Early

Indicators of Future Requested Changes

Class	Response
I	New Information No One Could Have Control Over
I	Changed Site Conditions
I	Equipment Change
I	Historical Facilities Involved
I	Design Accomplished at Same Time as RD Work
M	Engineers Misunderstanding Request
M	Users Could Not Visualize Blueprints
P	Poor Planning
P	Personnel Change
P	Personnel Changing Their Minds
P	New Information Brought Out During Coordination
P	Real Requirement Brought in Coordination Process
P	Bad Information
P	Spare Parts
P	Incomplete Coordination

Meaning of Letters: I - Information No One Has Control Over
M - Misunderstandings
P - Poor Staff Work

Table I.2

Frequency and Difficultly of Characteristics to Evaluate User Change Requests

Classification Type	Category Type	Response	Count and Importance Score	Weighted Difficulty Score
Attribute	Execution	Cost of Request	35	1.67
Attribute	Execution	Schedule Impact	26	2.00
Attribute	Execution	In Scope (Legal)	15	1.60
Attribute	Execution	Complete and Usuable Facility	9	1.33
Attribute	Execution	Is Change Valid	8	2.33
Attribute	Execution	Is Request Gold Plated	3	1.00
Attribute	Execution	Constructability	3	1.00
Attribute	Execution	Does Request Require Rework of Completed Work	3	3.00
			Subtotal = 102	AVG = 1.74
Attribute	Others	Who Submitted Request	6	2.00
			Subtotal = 6	AVG = 2.00
Attribute	Quality	Is Request a Want or Need	20	1.71
Attribute	Quality	Impact to Mission or Mission Essential	20	1.71
Attribute	Quality	Functional Benefit to User	8	2.67
Attribute	Quality	Time Requirements (How Soon Does User Need Change)	6	1.50
Attribute	Quality	Benefit to Government or Air Force	6	1.33
Attribute	Quality	Life Cycle Cost (Economic Analysis)	5	2.00
Attribute	Quality	Critical Need Date	4	1.00
Attribute	Quality	Community Appearance	3	3.00
Attribute	Quality	Improve Morale	2	3.00
Attribute	Quality	How Sensible Is Request (Magnitude)	2	1.00
Attribute	Quality	Maintenance of Real Property	2	1.00
			Subtotal = 78	AVG = 1.81

Table I.2 (Continued)

Classification Type	Category Type	Response	Count and Importance Score	Weighted Difficulty Score
Influence	Execution	Funds Avalability	23	1.13
Influence	Execution	Design or Construction Status	6	1.00
Influence	Execution	Balance Execution to Customer Satisfaction	3	1.00
Influence	Execution	Percent Constructed	3	2.00
Influence	Execution	Guidance in Management Plan	3	1.00
Influence	Execution	Guidance in P.M. Design and Construction Manual	3	1.00
Influence	Execution	Funding Source and Expiration Date	3	1.00
Influence	Exectuion	PA/CWE Ratio	3	1.00
Influence	Execution	Design Fund Status	2	1.00
Influence	Execution	Historical Official Guidance on Change Requests	2	2.00
			Subtotal = 51	AVG = 1.21
Influence	Others	MAJCOM Opinions (MAJCOM Support)	8	1.33
Influence	Others	Top Level Management Opinions	5	2.00
Influence	Others	Project Types	3	1.00
Influence	Others	Outside Professional Opinions	3	2.00
Influence	Others	Best for BCE	2	1.00
Influence	Others	On-Site Personnel (SATAF) Opinions	2	2.00
			Subtotal = 23	AVG = 1.56
Influence	Quality	Technical Evaluation (Against ETLS and Manuals)	11	1.25
Influence	Quality	Quality of Facility	6	1.50
Influence	Quality	Compare Against Facility Requirements Plans	4	1.50
Influence	Quality	Command Special Interest in Project	3	3.00
Influence	Quality	Long-Term Use of Facility	3	1.00
			Subtotal = 27	AVG = 1.65
Predisposition	Others	Are Other Options Available	8	2.00
Predisposition	Others	Professional Experience	6	1.00
Predisposition	Others	Knowledge of User and User Mission	3	2.00
Predisposition	Others	Common Sense	3	1.00
Predisposition	Others	Seek User Assistance to Offset Cost, Scope Growth	3	2.00
Predisposition	Others	Individual Talent	3	3.00
Predisposition	Others	Smart Idea at Wrong Time	2	3.00
			Subtotal = 28	AVG = 2.00

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This research examines the evaluation process of Air Force design and construction project managers on user requested changes to facility construction projects. Project managers who incorporate user requested changes probably enhance the facility quality, but also adversely affect the project execution (on time and within available resources) and the Air Force image before Congress. The researcher interviewed 27 experienced project managers in 3 different organizations on their decision-making processes to balance the tradeoffs between cost, performance, enhancing user productivity, and schedule.

This research employs a "reason analysis" methodology. Therefore, this research develops rather than tests a specific hypothesis. Frequency counts and open-ended questions help show the most important criteria in the decision making process. Relating responses of various questions helped the researcher gain insights into the change request process in general.

The research developed an information guide for use by Air Force project managers when evaluating user change requests. This guide helps to educate project managers from the experiences of other project managers.

Evaluating user change requests includes the following three major areas: their early detection, the administrative process, and the evaluation factors. Early detection of user change requests are derived from factors that caused revisions to the original change request. The administrative process includes those procedural items judged most important by the interviewees. The research divided the evaluation factors into two classifications. The first group addresses why project managers act as they do in evaluating the requests. The second group identifies the factor associated with either the facility quality or project execution. Also, the research scores these evaluation factors according to their importance and difficulty of use, as perceived by the project managers.